PUBLISHED EVERY SATURDAY BY
THE W. J. JOHNSTON COMPANY, Limited,
41 PARK ROW (TIMES BUILDING), NEW YORK.
Established 1874. Incorporated 1889.
Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 927 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.
(Including Postage in the U. S., Canada or Mexico.)

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The first issue of				1888 cont'ined	175	different	adv'ts.
1881 contained	28	different	adv'ts.	1889 "	234	"	"
1882 "	45	"	"	1890 "	289	"	"
1883 "	63	"	"	1891 "	325	"	"
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Of no issue of The Electrical World for years have fewer than 9,000 copies been printed and published, while for a long time no issue has consisted of less than 10,000 copies, and the number of copies actually printed and published has of late in many instances reached 11,500. Mr. Johnston holds himself personally responsible for the accuracy of these figures and for the statement that no other electrical journal in America, or in Europe, or in the world, regularly issues one-third as many copies.

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Special Notice.—*The Western office of The Electrical World, which has for several years been located at 465 The Rookery, Chicago, will hereafter be found at 936 Monadnock Block, where larger, more convenient and more cheerful quarters have been obtained in the new wing known as "Section C." This addition to the original building is really not yet entirely completed in its internal arrangements. For instance, the elevator which is to run in front of The Electrical World's office will not be in commission for several weeks, but in the meantime one of the other elevators, of which there are a dozen or so, can be taken to the ninth floor. It is to be hoped that the Chicago friends of The Electrical World and those visiting the World's Fair city will make a point of visiting the office, where they can always rely upon a cordial welcome.*

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The New President of the Institute. THE American Institute of Electrical Engineers is to be congratulated upon its selection of a president for the ensuing year. With an international professional reputation Prof. Houston is peculiarly fitted for the position during a year when the Institute will take on an international character. As an official host his affable personality will be highly appreciated by the many visiting electricians with whom he will have relations, and as its presiding officer the Institute has the assurance of a dignified and courteous discharge of the important functions of that office.

Dynamo Graphics. THE tendency in these days seems to be toward the graphical rather than the analytical solution of problems, and this has been especially noticeable in electrical literature. It has been applied to most every branch of the field, but more universally, perhaps, to electric lighting in the form of wiring charts and diagrams and to alternating currents. Elsewhere in this issue Mr. Arthur H. Allen, in an article on "Dynamo Graphics," applies the same treatment in a very interesting manner to dynamo design. There is a wide difference of opinion as to the value and utility of graphical methods. To some they appeal strongly, and are much more simple and satisfactory than analytical methods accomplishing the same results, while with others it is exactly the reverse. Without doubt this mode of attacking a problem is often the best, but it is a privilege which stands in great danger of abuse, and is frequently carried too far.

Electricity in England. IN this week's Digest we print an abstract from Prof. Ayrton's introductory monograph to the Electrical Section of the British Catalogue at the Chicago Exposition, which gives a very interesting summary concerning the state of electrical applications in England. From its contents the conclusion can be drawn that our English cousins are vastly behind us in almost every branch except telegraphy, and particularly in electric traction, which has assumed such vast proportions in this country. The use of electric launches, gas and oil engines, on the other hand, is more general there, and the figures given as to the expense of operation of the two latter are rather startling. The statement is made that, with Dowson gas, large gas engines can develop an indicated horse power on four-fifths of a pound of coal per hour, and that the consumption of oil per hour per brake horse power of the Priestman oil engine is said to be only one pound. The steam turbine is also favorably referred to and seems to be coming into general use in England. There are several lessons to be learned from this very interesting summary and particularly in relation to the matters to which we have referred.

New Electric Meter and Meter Clock. WE describe in this issue two new English inventions, an electric meter designed by Mr. Anthony Reckenzaun and Mr. J. A. Pentz, and a meter clock designed by Mr. Gisbert Kapp. The former is apparently based upon the Aron meter, but the clockwork arrangements and springs are replaced by electrically driven clocks, thus greatly simplifying the meter, it is claimed. The differential meter clock of Mr. Kapp is somewhat similar in part of its mechanism to time cut-outs that have been employed in this country for turning off arc lights at a given hour, but the shunting arrangement for diverting part of the current is the novel feature. In places where the day rate is made lower than the night rate, which practice will probably come more and more into use as its advantages are recognized by both producer and consumer, a simple meter will of course no longer answer. In London several methods have been devised to obviate this difficulty in registering, but the solution of Mr. Kapp seems to be by far the neatest as well as the simplest yet devised. The principle is very simple, a clock cutting in and out at given hours a shunt through which a certain proportion of current, corresponding to the difference in price, is shunted during the hours of the cheaper rate.

Municipal Electric Plants. THE newspaper press gives evidence that an increasing interest is being taken in the subject of municipal ownership of street electric lighting plants. At the present time a number of cities in New England are considering the matter and Detroit and a number of smaller cities and towns elsewhere are agitating the same subject. About six per cent. of the street-lighting plants are already thus owned, and in several instances commercial lighting is also done from town plants. In communities like typical New England ones there is much to be said in favor of municipal ownership, but it is doubtful if the plan is feasible in the majority of towns, and particularly cities, owing to the abuses that would arise through political mismanagement. The figures generally quoted by municipal authorities as to the cost of lighting from such plants should not be accepted in the absence of details, as the interest on the investment and depreciation are frequently not included. On the other hand, as a rule, the light is generally better than that often furnished by contract, the lamps being usually run at full candle power. In England the tendency of popular opinion is strongly toward the general supply of electricity by the local authorities, and we learn that of 25 towns there in which plants were installed last year, in 17 they were undertaken by the local authorities. In this connection it will be well to remember, however, that English municipalities are governed far differently from American ones.

Medical Currents from Commercial Circuits. THE letter of Dr. Waite in our last issue and that of Dr. Hutchinson in our present one call attention to a matter of importance to which heretofore apparently little attention has been given. Owing to the great convenience, physicians now frequently substitute a current taken from a continuous circuit incandescent system for the primary battery current usually employed with medical apparatus. Where arc, primary alternating or trolley wires are also jointly employed an element of danger is introduced that is more or less remote, depending upon their relative disposition. If a cross occurs such that the circuit being employed in medical treatment is subjected to high voltages from the circuits referred to, the fact that a lamp or fuse will almost instantly break the circuit will not prevent a violent shock from being given, that in the case of a sick or delicate person may be fatal, even should the current in itself be too instantaneous to be harmful. Where the incandescent circuit is an overhead one, the probability of a cross either direct or through dead telegraph or metallic circuit telephone wires is, of course, much greater than if it were underground. In the latter case, however, a danger still exists from the use of high-tension arcs in interiors where there are incandescent circuits, and from metallic telephone circuits, and in the three-wire system this is greatly increased if the neutral is grounded. In the series arc system the effect will depend upon the relative position of the cross and ground on the arc circuit, but not in a multiple system like that of trolley or alternating circuits. In any system, leaving aside the improbability of a double cross, a ground is necessary on both the high-tension circuit and that in use; this, however, always exists on a grounded three-wire circuit, thereby reducing the security it otherwise possesses, and the patient himself may form one of the grounds. In conclusion, it may be stated that, while the probability of danger from the medical use of commercial circuits is more or less remote, it nevertheless exists, and the physician who wishes to take no chances should not use a commercial circuit that may directly or through other wires come in contact with a high-tension circuit.

The Institute Papers. THE papers read at the recent meeting of the American Institute of Electrical Engineers are of a practical character, with the exception of probably the most important one, that of Dr. Pupin, on electrical resonance. While not nearly as many were presented as at the last general meeting, there is less padding, and the net result does not indicate any falling off. The paper of Dr. Pupin (which was read in the laboratory of Columbia College and illustrated by experiments) on electrical resonance, and that of Prof. Carpenter on economy of steam engines, are the most important, and each marks an advance in the branch of science of which it treats. That of Dr. Pupin has not yet been printed, and, owing to the complexity of the subject treated, extended comment will be reserved for another issue. By means of a mechanical analogy Dr. Pupin illustrated the phenomena of oscillatory discharges, and an ingenious apparatus enabled any rate of oscillation to be attained, the selection of a definite harmonic being accomplished by the comparison of the note of a tuning fork with the sound of a telephone through which the current being studied was passed. Another point of importance treated was the effect of capacity in raising an impressed E. M. F.—the so-called Ferranti effect; it was shown there is no theoretical limit to the E. M. F. that may be thus obtained, and an arrangement was shown through which over 1,000 volts were obtained from an impressed E. M. F. of less than 100 volts, fear of injuring the condenser only having limited the experiment to that voltage. The reading of the paper was followed by some remarks by Mr. Nikola Tesla, which were listened to with an interest enhanced by the charming personality of the speaker. Prof. Carpenter in his paper develops formulæ based upon actual experimental data to express the efficiency of a given type of steam engine working at different loads. In view of the uncertainty that has heretofore existed in regard to this point, which is one of great importance in connection with engines driving electrical machinery, the value of such an investigation is evident. As far as we know, this is the first systematic attempt made to definitely determine and express in practical working formulæ the efficiency of engines at varying loads, and should go far toward settling the many disputes there have been on this subject. The practical application of the paper is simplified by the accompanying tables and the examples worked out under the different heads. The paper of Mr. Charles P. Matthews (abstracted in another column) brings out the effect of the time element and of the length of a fuse on the strength of the fusing current. The result of an investigation of the effect of the alternating current on fuses warranted the conclusion that there is a distinct rise in the resistance of a fuse on an alternating circuit, which may perhaps be accounted for by a change in the molecular structure of the metal, and that results in the decided lowering of the fusing current, which may be sufficient to affect the reliability of the fuse. While none of the points treated of in this paper are at all new, yet it has a distinct value from giving the results of systematic experiments, thus furnishing a solid basis for the facts established.

Annual Meeting of the American Institute of Electrical Engineers.

The annual meeting for the reception of the yearly report, the election of officers, and other business proceedings was held at the headquarters of the Institute, 12 West Thirty-first street, at 4 p. m. on Tuesday, May 16, and was attended by a large number of the members. The reports of the council and treasurer and committees were received and some matters of business discussed, including the proposition to hold meetings of the Institute in other sections of the country. The report of the council for the year ending April 30, 1893, shows that in addition to the general meeting of the Institute held at Chicago last June eight other meetings have been held in New York City, at which some 30 papers and reports were read and discussed, and have since been printed and distributed to the members. The volume of the transactions for 1892 contains 858 pages, and is about one-third larger than that of the preceding year. In response to an inquiry by the direction of council the authorities at the World's Columbian Exposition have assigned two rooms in the Electricity Building to be occupied as the headquarters of the Institute during the Fair, and these rooms are now being fitted up. The general committee of the Institute and its sub-committee on provisional programme have been actively engaged during the year in assisting in preparations for the World's Electrical Congress of 1893. An important change has been made in the plan of issuing the Transactions by which the various papers and discussions are now printed at an earlier date than was previously possible, the additional expense being met by the acceptance of suitable advertisements. The plan has been found to be very satisfactory. Designs have recently been approved by the council for a badge and certificate of membership. During the past year there have been elected three honorary members; 98 associate members, and one has been restored to membership, making the total membership of the Institute 717. Nine resignations have been received, and the Institute has lost 11 members by death, including Cyrus W. Field, Dr. Werner Von Siemens, Dr. Norvin Green and Grosvenor P. Lowrey.

The treasurer's report shows a balance from the previous year of $245.53, and the receipts from the secretary amount to $7,552.67; the disbursements amounted to $7,707.30, leaving a balance to the new account of $90.90. The building fund, with accrued interest, now amounts to $850.

Pres. Edwin J. Houston.

For the election of the officers there were two tickets in the field, one prepared by the council, headed by T. D. Lockwood as president, and the other, an opposition ticket, placed Edwin J. Houston in nomination, the rest of the ticket being the same as the council ticket, with the exception of one vice-president. As the result of the ballot the following officers were chosen: President, Edwin J. Houston; vice-presidents, H. Ward Leonard, Patrick B. Delany, William Wallace; managers, Charles Hewitt, W. J. Hammer, H. J. Ryan and J. J. Carty; treasurer, George M. Phelps.

The name of Edwin James Houston, the new president of the Institute, has been familiar not only to electricians but to the general public for many years. His numerous recent contributions to electrical literature have tended to bring him into still greater prominence in the electrical field, and, therefore, it seems especially fitting that he should occupy this important position during the coming year, when so many electricians of note will visit this country from abroad.

Mr. Houston was born in Alexandria, Va., in 1844, and received his early education in the public schools, first district of Pennsylvania. He was graduated from the Central High School of Philadelphia, and afterward studied abroad. For awhile he was instructor at Girard College, and afterward was elected professor of civil engineering in the Central High School, being transferred a year or two later to the chair of natural philosophy, which he has since occupied. He took up the subject of electric lighting in its early days, and in connection with Elihu Thomson developed the system which now bears their names. He was appointed by the United States government in 1884 a member of the United States Electrical Commission which met in Philadelphia, and was also chosen by the Franklin Institute as the chief engineer of the International Electrical Exposition. The work done at that time has become a matter of history, and Prof. Houston took a prominent part in its successful completion. In addition to holding the professorship of physical geography and natural philosophy and that of physics in the Franklin Institute Prof. Houston has been one of the editors of the "Journal of the Franklin Institute," besides being a member of the American Philosophical Society, American Society for Physical Research, American Institute of Electrical Engineers, the Franklin Institute and other bodies. Among some of his numerous contributions to the literature of natural science may be mentioned "Elements of Philosophy," "Elements of Chemistry," "Primer of Electricity," "The Telephone," "Electrical Furnaces," "Dictionary of Electrical Words, Terms and Phrases," "Advanced Primers of Electricity," etc., etc. The current scientific periodicals, especially the "Journal of the Franklin Institute," have contained many papers by the same author.

Prof. Houston has devoted considerable attention to public lecturing, in which he has been particularly successful. His time for many years has been devoted to private research, and many important facts have been brought out by him.

The annual dinner at the Arena in the evening proved as great a success as that of last year, and over 60 persons were seated at the table. After an excellent dinner the new president called upon Mr. Frank J. Sprague, the retiring president, to act as toastmaster. The speeches were interesting and well received. The following gentlemen responded to the invitation of Toastmaster Sprague: President E. J. Houston, T. D. Lockwood, C. E. Emery, T. C. Martin, E. G. Willyoung and Frankland Jannus.

THE GENFRAL MEETING.

The general meeting of the Institute, which took place at the headquarters, was well attended, and the reading of the papers was followed with interest. At the morning session Mr. C. P. Matthews read a paper "On the Behavior of Fuse Metals in Direct and Alternating Current Circuits;" Lieut. Charles D. Parkhurst one on "A Modified Deprez D'Arsonval Galvanometer;" Prof. R. C. Carpenter read a paper on "The Variations in Economy of the Steam Engine Due to Variation in Load," and Geo. S. Moler one on "An Automatic Printing Speed Counter for Dynamo Shafting." These papers were discussed to a greater or less extent. At 1 p. m. a recess of an hour was taken and a collation was served at the Arena, which was fully attended and appreciated by the members.

At the afternoon session the World's Electrical Congress of 1893 was brought up for discussion, and Mr. E. G. Willyoung, of Philadelphia, read a paper on "A New Method and Apparatus for Measuring Conductivity," and Messrs. A. H. and C. E. Timmerman presented their paper on "The Heating of Armatures." The meeting then adjourned to Columbia College, where Dr. Pupin gave a paper on the "Practical Aspects of Electrical Resonance." It was decided that it would be better to have the lecture take place there, as the apparatus at Columbia College was available for the illustrations which Dr. Pupin especially desired to make.

At the invitation of Dr. S. S. Wheeler and Prof. F. B. Crocker, of the Crocker-Wheeler Electric Company, a large number of the members of the Institute on Thursday afternoon visited the new works of that company, at Ampere, N. J., where they were shown through the various buildings by the superintendent, Mr. August Hartman, Mr. Gano S. Dunn, the electrical engineer, and his assistant, Mr. A. W. K. Peirce. As described in a former issue, shafting is entirely dispensed with in these works, and the power transmitted from generators, centrally located, through lines of copper rod conductors. All of the machine tools are driven by motors, which are component parts of the machines themselves, and electrical connections simply made to the nearest line of conductors. The machines are stopped, started or varied in speed by a rheostat placed conveniently on the frame. Much interest was manifested in the motor-machine tools, with which the works are entirely supplied, and the great convenience of the system and the saving from absence of the friction of innumerable shafts, pulleys and belts constructed upon. It was remarked that for testing and special applications this system is especially convenient, as it takes but a few minutes to make the power connections, and a tool may be moved to the most advantageous position to do its work.

The Official Badge of the American Institute of Electrical Engineers.

For a long time an effort was made to secure a badge of some appropriate design which would meet with the approval of the Institute and find general favor among the members. In the accompanying illustration is seen the badge which was finally approved by the Committee on Badge and Certificate, which consisted of Dr. F. Benedict Herzog, Horatio A. Foster and William J. Hammer. Its shape is that of a Franklin kite, which represents static electricity, and is a recognition of America's first electrician and philosopher. It is also a diagrammatic representation of a Wheatstone bridge, a well known piece of electrical testing apparatus. A galvanometer, equally familiar, is intended to represent magnetism and induction. The amber of which the galvanometer is made calls attention to the first conception of electricity, dating back to some 600 years before Christ. Over the top of the galvanometer are found the letters A. I. E. E., the initials of the Institute; and the well known formula of Ohm's law is placed below.

The pin is made of white enamel with the lettering and front portions of 18k. gold, and the back of 14k. gold. They can be obtained by application to the Secretary, R. W. Pope, 12 West Thirty-first street, New York City, for the sum of $3 each.

The Chicago World's Congress of Electricians.

The following communication has been received from Professor Gray, the Chairman of the World's Electrical Congress Committee:

To the Editor of The Electrical World:

Sir: We have the pleasure to announce, that in accordance with the expressed wish of the American branch of the Advisory Council of the World's Congress of Electricians, the Secretary of State has appointed Prof. H. A. Rowland, Johns Hopkins University; Prof. T. C. Mendenhall, Superintendent, Standard Weights and Measures; Prof. H. S. Carhart, Michigan University; Prof. Elihu Thomson, Lynn, Mass., and Prof. E. L. Nichols, Cornell University, to sit in the Chamber of Delegates as the duly authorized United States delegates.

While there are many electricians in the United States who could fill with dignity and credit to the profession this honorable and responsible position, yet the profession is to be specially congratulated that the United States will be represented by men of such high standing both as gentlemen and members of the profession.

We also have the pleasure to announce that the Royal Commission has named W. H. Preece, Prof. S. P. Thompson, Prof. W. E. Ayrton, Major Cardew and Alexander Siemens as delegates from Great Britain.

There is every reason to believe that the success of the Congress is now assured, and that all the important countries will be fairly represented. Elisha Gray.

Currents from Commercial Circuits for Medical Purposes.

BY W. M. HUTCHINSON, M. D.

There appears on page 377 of the issue of May 20 of The Electrical World a communication from Dr. Waite that caused me some surprise, at the same time that it awakened much interest in my mind. I refer to the doctor's allegation that the use of the electric light current for electro-medical purposes is attended with danger to the patient.

While not an electrical expert I have paid some attention to electro-physics, and have had some experience with the use of such current in a medical way, having had for upwards of two years an apparatus in nearly daily use by means of which either galvanic or faradic electricity can be applied, the current being derived from the Edison low-tension system, and so far have no accidents or mishaps to report.

Now, if it be true, as Dr. Waite believes, that there is danger, no matter how slight, attending the use of such current, it is certainly the duty of the members of the profession of electric engineering to advise us, the medical practitioners, as well as the apparatus makers, of such danger at once, and no way better than through the columns of a reliable and well conducted electrical journal like your own, for there can be no question as to where the blame would rest were any one injured or killed in this way.

It seems to me that the public would never think of calling to account the instrument manufacturer or the electric light company, but would place the sole responsibility upon the doctor who is supposed to be possessed of at least reasonable and ordinary knowledge of the actions and properties of any agent that he may employ for the relief or cure of disease, and that he shall adopt no measure that has not been sanctioned as proper and legitimate by its general use by the profession, or some branch of it.

Without wishing to enter into a minute discussion of methods or devices for insuring safety. I simply wish to state my belief, in conclusion, that if fuse wires of very low capacity, say one ampere, and also a lamp of low amperage, such as a night lamp, are placed across the circuit before it enters the medical apparatus, that no circuit dangerous to life could ever enter the patient, even were short circuits or crosses to take place with the mains of arc light, alternating incandescent or trolley systems. Here in Brooklyn we are certainly safe at all events, as the low-tension wires are all underground, except the returns of the trolley currents, which are only operated at 500 volts, and are not, therefore, fatal, while the arc light wires are all overhead.

Where the Telegraph is Least Used.

The four countries in the world, says the "Hartford Courant," which possess the smallest telegraph facilities are Peru, Paraguay, Uruguay and Persia. In the first named there are only thirty-six telegraph offices in the whole country, and but 1,600 miles of wire. In the territory of Paraguay there are only 510 miles of wire in operation, and the entire telegraphic service of that country requires the services of but twenty-eight persons. One line of 360 miles, owned and operated by the government, runs from Asuncion to Paso de Patria, the limit of Paraguayan territory, and the other 150 miles by the railroad from Asuncion to Pirape. Owing to high water and camp fires in that country the line is often interrupted for days at a time.

Electricity at the World's Fair.

VERY person interested in any way in the electrical features of the World's Fair has reason to rejoice at the progress made during the past week. Not only in the completion of the power plant, fixing up odds and ends of lighting and power circuits, has great progress been made, but also in the Electricity Building, where many exhibits have been completed. The backward condition of this building has already been commented on, and many people are inquiring why that most progressive and enterprising branch of American industry, electricity, should be apparently the slowest at this great Exposition. The most serious trouble experienced by exhibitors has been with the railroads. Even now, three weeks after the opening, some exhibits have not as yet arrived on the grounds, the delay being wholly caused by the lack of attention and interest on the part of the railroads, Another element of trouble has been the great scarcity of skilled labor. With so much to be done on the fair buildings, and with but a limited number of men to do the work, it is not strange that the exhibitors should be the last to receive attention. The spectacle of the half finished German section reminds one of the great need of more labor. A few days ago all the workmen on this important section were withdrawn to help complete the magnificent display which the Fatherland is making in the Manufactures Building, and people are wondering when the much-neglected Electricity Building will have them back.

The truly great exhibit which the General Electric Company is making is most complete. They are now placing the last heavy piece of machinery, and in a day or two everything will be in ship-shape. It will take a few days more to finish the centre tower of light; but the whole thing should be perfect by the end of the week. At the Paris Exhibition of 1889 the Edison exhibit was one of the features most favorably commented upon, leaving all of the European electrical firms far in the rear; at the Columbian World's Fair the General Electric Company apparently does not propose that they shall be accused of doing injustice to the occasion or permit the pre-eminent place one or other of its component companies have heretofore held at exhibitions to be occupied by another at Chicago.

Last Saturday the weather was delightful and the grounds for the first time assumed a pleasant character, and a view of the lake was not accompanied by a chilly feeling. The grounds were invaded by bands of school children, the admission for these on Saturday having been reduced to 25 cents. Notwithstanding the large attendance on that day, the net result for the week has not been satisfactory. The greatest attendance was on Norwegian Day, Tuesday, when it was 62,000, and the smallest on Thursday, when only 27,000 tickets were sold. The average attendance thus far has been only 33,000, while it must reach 90,000 in order to pay expenses. If the turnstiles record on an average 90,000 a day for the entire period of the Fair the bare running expenses of the show will be met. The concessions and side shows are productive of considerable revenue, and from this source the stockholders may expect a small rate of interest on their investment. In computing the attendance, a comparison is generally made by most of the papers with the figures at the Centennial, which gives the impression that the attendance is tremendous. The crowds are large, but they must be on an average four times as great as those at the Philadelphia Exposition, as the World's Fair cost about $32,000,000, while the Centennial represented an outlay of only $8,000,000.

The announcement that the grounds would be illuminated last Saturday night brought out an immense concourse of people. At least 75,000 people passed through the turnstiles. The lighting effects were really pretty. The Administration Building was exceedingly handsome in its garments of light, the streams of incandescent lights being augmented by a number of great torches around the base of the dome. From a distance the effect was very impressive.

After the Administration Building had been lighted current was turned into the thousands of lamps that describe a fringe around the Grand Basin. These lights are but a few feet from the water, the surface of which reflected the light as only water can. Rising sentinel-like every twenty-five feet, the ornamental arc lamps added their brilliant rays which showed off the white of the massive buildings to the best possible advantage. All the colors of the rainbow were thrown on the rising waters of the electric fountains on each side of the McMonnies fountain, and the balustrade bordering the basin was lined every inch of the distance with the admiring throng. An additional attraction was furnished by a band playing on a float, which rested on the middle of the basin. Other bands also added instrumental melody to the occasion. All the great search lights were in operation, throwing conical shafts of light long distances from the roofs of the Manufactures and Agricultural Buildings and Music Hall on the various parts of the Exposition, principally the Administration Building, with its gilded dome flaming with gas torches and bands of incandescent lights. Before the lights flashed out from every structure and every avenue of approach, the view in the gathering darkness from the bridge on the south side of the Grand Basin was like a glimpse of Fairyland. But descriptive efforts are useless to give any adequate idea of the picture. It was grand, and yet extremely picturesque. There was an immense throng about the basin, and all agreed that electricity was indeed the crowning glory of this pride of nations.

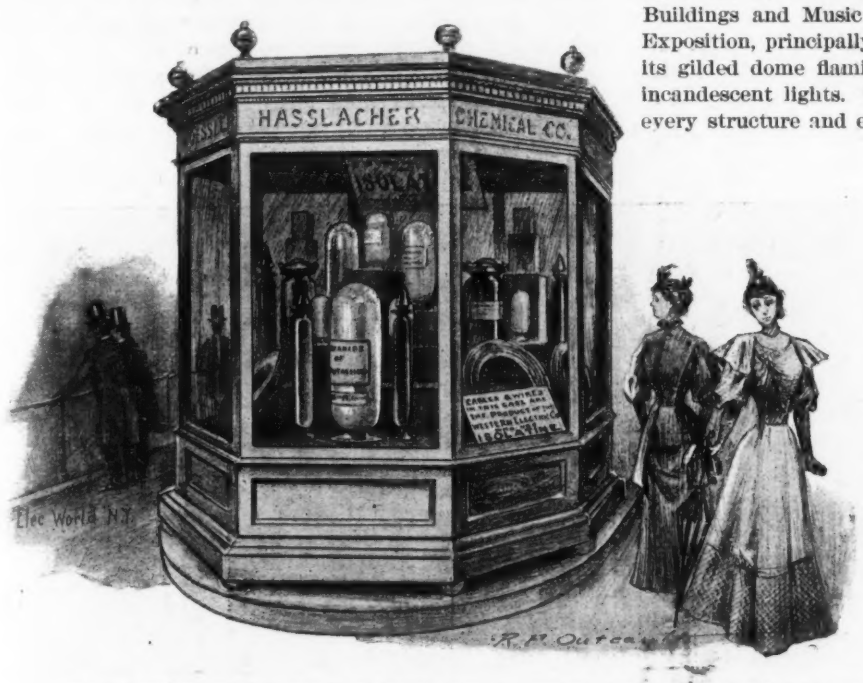
Among the exhibits already complete and winning many compliments may be mentioned that of the Paiste switch, shown in the accompanying illustration. This is located in an extremely favorable position, being visible from all parts of the building. It is the wall space in the southwestern part of the gallery, and is in the form of an arch, the background being of robin's-egg blue. On this blue ground an immense eccentric has been formed of Paiste switches, the name of the company being described in the circle. A display board shows "The Evolution of the Switch." Here are arranged a score or more of switches illustrative of the different stages of switch manufacture. The first one bears this interesting legend: "The first switch manufactured by H. T. Paiste. It was removed from the Presbyterian Church, Downingtown, Pa., after five years' service. It is one of 100 made by means of a hand drill, hammer and chisel." The exhibit has been much admired for its arrangement. It is indeed unique, considering that only one article is used in the display.

Coming down stairs, the Belknap motor, manufactured by the Belknap Motor Company, of Portland, Me., shows to good advantage, operating a number of coffee mills. The points of excellence in this motor are already well known, so that we need not dwell on them here. The coffee mill, however, is unique. It is manufactured by the Belknap company, and can be operated by either an electric or water motor. It is claimed that ten cents worth of electricity can grind from 200 to 250 pounds of coffee, while for manual power the cost would be twenty times as great.

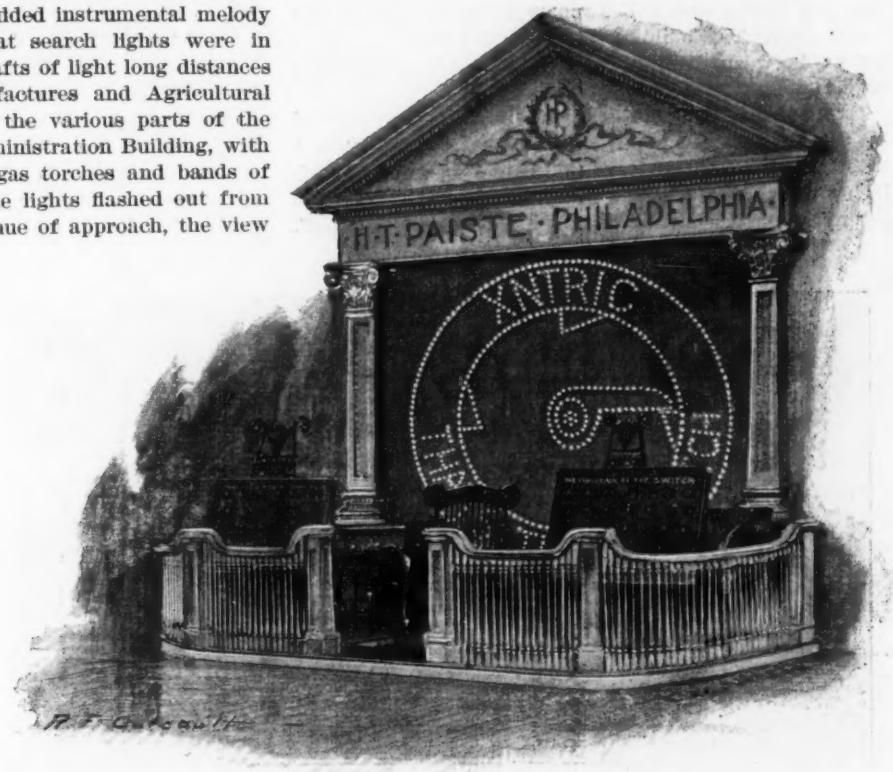
The Electricity Building is hardly the place one would look through to find a chemical exhibit. A very handsome one of this character, however, is that made by the Roessler & Hasslacher Chemical Company, of New York, which is also shown here. The exhibit embraces a full line of specimens of all chemicals that enter into electrical operation and manufacture. They also show their celebrated "Isolatine" paint, which has been largely used for insulating purposes.

Many other exhibits are practically complete, but the unsettled state of affairs on the ground floor gives to visitors the impression that the building is away behind, and consequently they hurry through. With all the dazzling displays of light which have been arranged for, and the popularity of electricity among the people, it is easy to see that this building will be one of the most favored with attendance of any in the entire White City.

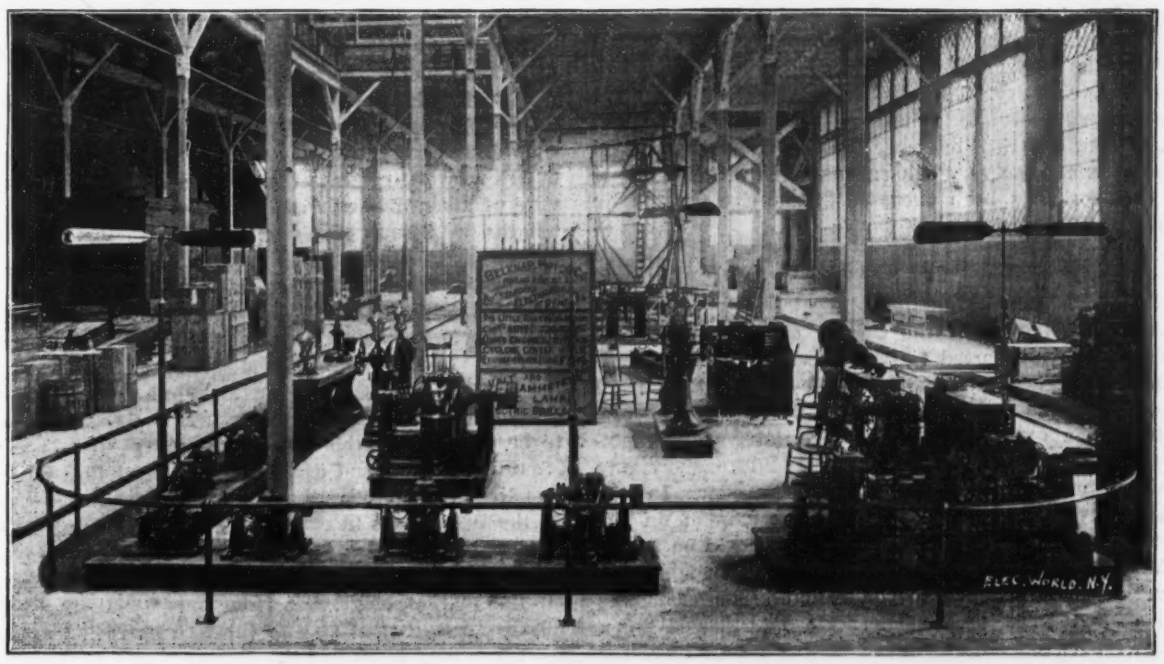
Great disappointment has been felt that the electrical fountains are as yet inactive. It is promised that these will be ready within a few days, in which event many people will visit the grounds at night, as they certainly will be one of the chief features of the Exposition.



THE EXHIBIT OF THE ROESSLER & HASSLACHER CHEMICAL COMPANY.



THE EXHIBIT OF H. T. PAISTE.



THE EXHIBIT OF THE BELKNAP MOTOR COMPANY.

Brightwood & Takoma Park Electric Railway, Washington, D. C.

This line commences at the Boundary and Seventh street, northwest, and runs due north on Seventh street, extended to Brightwood and Takoma Park, with single track extending to Silver Spring, Md.

The entire length is about six miles, the section of the district through which it passes being one of the most popular for suburban residences.

For some distance from the city the Johnson grooved rail is used, while 56-pound "T" rail is used over the balance of the line.

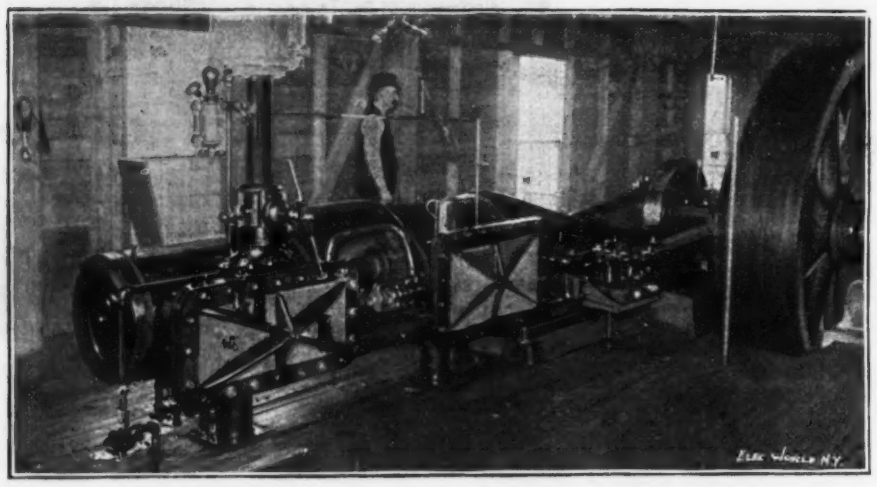
The centre pole construction is used, the poles being of iron in the immediate vicinity of the city, while a neat wood pole is in use in the country.

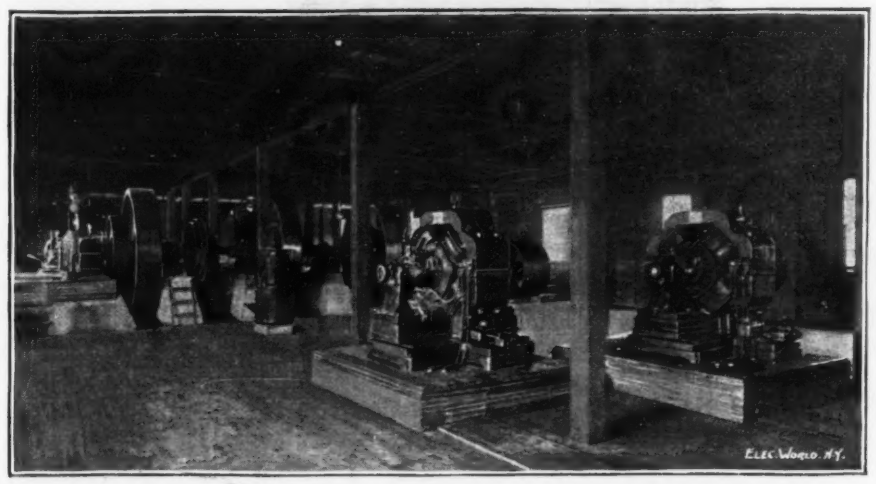
Oak ties placed 2½ feet centre to centre, firmly set in crushed rock ballast, form the roadbed. The rails are bonded throughout in the usual way. The trolley wire is of No. 0 hard drawn copper, supported upon brackets of neat design.

Feeders of the required capacity distribute the current as is usual with lines of considerable length.

The power house is located at Brightwood, about 3½ miles from the city. The building is a frame structure, substantially built, and is so planned as to afford storage capacity in the upper story for the six motors now in use, the engine and boiler rooms being located on the lower floor. The building is 40 by 125 feet, has three tracks, between the rails of which are pits to facilitate repairs upon trucks and motors.

Two Belmont tandem compound engines, manufactured by Clarke Bros., Belmont, N. Y., and shown in Figs. 1 and 2, are used. They have cylinders 11½ and 18 by 24-inch stroke. The engines, which run at 160 revolutions per minute and are rated at 182 h. p. each at ¼ cut-off,





FIGS. 1 AND 2.—THE BRIGHTWOOD AND TAKOMA PARK ELECTRIC RAILWAY, WASHINGTON, D. C.

are direct coupled to a jack shaft carying two driving pulleys 108 inches in diameter, and two balance wheels weighing 14,000 pounds each. The shaft is supported in self-oiling bearings resting upon five stone piers. Four friction clutches afford ready means of connecting generators to either or both engines.

The generators are of the Thomson-Houston multipolar type, having a capacity of 10 kilowatts each. The switchboard has marbleized slate panels, upon which are mounted the usual switches, meters and circuit breakers.

Steam is furnished by a battery of tubular boilers of 400 h. p. capacity. The electrical portion of the plant was erected under the immediate supervision of Mr. S. P. Thompson, electrical engineer for the Thomson-Houston Company, and the very efficient maner in which this part of the work has been executed is but a characteristic feature of his work.

Magnetism and the Human Body.

Mr. A. E. Kennelly, of the Edison laboratory, and Dr. Frederick Peterson, of the College of Physicians and Surgeons, have reported to the American Electro Therapeutic Association the results of their experiments on the effect of magnets on the human body.

Experiments were tried on cats, frogs, boys, and themselves. Human and frog's blood failed to show any traces of polarization, movement or vibration. In the case of live frogs, no influence of the magnet on the blood cells or the movement of the blood could be found.

To test the German theorists' claims that magnetism increases the resistance to conduction in motor nerves and causes paralysis, a small dog was placed in a cylinder between large field magnets and kept there for five hours under the influence of a strong magnetic current. The exposure seemed to have no effect on the dog, and he came out as lively as he went in. Then a boy was placed between the magnets and a magnetic current was turned on. There was no effect upon the boy. The magnetic current was strong enough to balance a heavy bolt in the air and to contract wires of iron and to hold iron chains so strongly that it required the efforts of several men to detach them.

Then the experimenters themselves and their men took turns in lying down on a board placed between the poles of a huge magnet with the current alternately turned on and off. One observer would hold the wrists of the subject and take sphygmographic tracing of the pulse. The second observer would observe the respiration, and the operator would turn the current on and off. No changes were observed in the tracings or in the respiration or in any other way. One subject held a steel screw in his hands; while he could tell from its attraction whether the current was on in the magnets, he had no sensations of any other kind.

The observers concluded that the human organism is in no manner affected by the most powerful magnets known, and that the brain and the nerves get no sensations or impulses from the magnets. They say that it may be possible that some day magnets may be invented where the number of reversals to the second is high enough and the force strong enough to produce effects on the nervous system, but that so far as the experiments show electro-magnetism seems to have no influence whatever upon the human body.

The Action of Continuous and Alternating Currents on Fuse Metals.*

BY C. P. MATTHEWS.

For the protection of electric currents from the passage and consequent heating effects of currents of abnormal intensities, no device is in more general use than the so-called safety fuse. Commercially the fuse appears in a variety of connecting devices and inclosing boxes, classed as thermal "cut-outs" and familiar to all having to deal with the distribution of electric energy. The protective element in all such consists of a wire or strip of some easily fusible metal of such current carrying capacity that it will melt under the heat developed by an excessive current. In points of simplicity, cheapness, ease of adjustment and low resistance, the safety fuse possesses advantage over most, if not all, electromagnetic safety devices. Experience shows, however, that unless certain conditions for successful working are carefully observed, the safety fuse may fall far short of furnishing satisfactory and reliable protection.

With a view of studying these conditions, and of obtaining at the same time reliable data on the fusion of conductors under circumstances closely approximating those of actual practice, a series of experiments, some of the results of which appear in this paper, were recently made in the physical laboratories at Cornell University.

To determine to what extent the fusing current is influenced by the cooling effect of the terminals, pieces of wire of given diameter and composition, but of varying lengths, were successively tested. The marked variation in current is shown graphically in Fig. 1, curve A. It will be noted that while an eight-inch piece fused at 6.6 amperes, a one-half-inch piece of the same wire carried 12.5 amperes, or an excess of nearly 100 per cent., before yielding. For lengths of this wire greater than six inches the conduction losses are practically nil in their influence on the value of the fusing current. The practical point to be observed at this juncture would seem to be this: Manufacturers cannot accurately rate their fuse wire unless the length of the specimen to be used is specified. In the fuse blocks in common use it is impracticable to use extreme lengths, yet if three-inch pieces were used the cooling effect would not be serious. Fuse blocks are on the market employing from one-half-inch to three-inch lengths of wire and all the variations indicated by the curve may be expected.

In the experiments with alloys of lead and tin, ordinary commercial metals were used, for, although the fusing current is effected by the presence of impurities, yet it was considered better to experiment with such grades of metal as would be used in practice. The alloys were cast in the form of cylindrical slugs, and these were drawn into wires varying in diameter from 10 to 100 mils. These were tested with great care.

* An abstract of a paper read at the tenth general meeting of the American Institute of Electrical Engineers, New York, May 17, 1893.

There is an important time element to be considered in connection with the phenomena of fusion. A certain interval elapses before the wire reaches the permanent temperature corresponding to a definite current. The duration of the current in this portion of the work was 60 seconds, experience showing that if a wire of moderate diameter did not fuse in that time under the action of a certain current it would not fuse at all. It should be noted also that unless massive terminals are used, they may, themselves, become heated, thereby checking the flow of heat through the ends of the wire and tending to promote ultimate fusion.

The experiments with the alloys indicate that the "three-halves power law" was quite closely followed, a result which was obtained in all the other cases. It was noted that while the temperature of fusion of tin is considerably lower than that of lead, its fusing current is about 24 per cent. higher. This is undoubtedly due to the difference in the resistance of the two metals. The specific resistance of tin is 13,360; that of lead 19,487 (C. G. S.). There is possibly also some difference in the emissivities of the two surfaces. Curve C, Fig. 1, illustrates the effect of inclosing the fusible wire in glass tubes. As would be expected, the convection is thereby checked and the fusing current very appreciably lowered. This is a point which should not be overlooked in practice; that is to say, the nature of the fuse block, whether closed or open, should be considered.

In order to ascertain the status of marketable fuse wire, a number of samples were obtained from different manufacturers and tested under conditions similar to those already described. The results were represented graphically by curves, only two sets of which are here reproduced. In Fig. 2, curve A is that obtained where two-inch specimens were tested, and, as will be seen, is not far from a 3-2 power curve. When, however, one-half inch pieces of the same wire were tested, curve B, much higher and distorted, was obtained. The marked cooling effect of the terminals is here apparent. Curve C is the most remarkable of all. One-half inch lengths of the same sizes of wire were successively fused in a porcelain ceiling cut-out block. This block was so constructed that the wire came in contact throughout its length with the cooling surface of the porcelain. The heat was conducted away so rapidly that the current reached the abnormal values shown before rupture occurred. For example, a seven-ampere fuse did not "blow" until more than 35 amperes were flowing in the circuit. The curve of rating should be of the same general equation as that of fusion, since both represent isothermal conditions.

The requirements for efficient safety fuse may be summed up as follows:

1. Promptness of action. 2. Low fusion point. 3. Permanency under normal conditions. 4. Moderately low resistance. 5. Firm and lasting contact.

Promptness of action requires that the temperature of fusion should not be too far removed from that attained when the wire is being worked at its rated capacity. Moreover, it is important that the metal should not undergo chemical changes produced by the action of the heat which may appreciably alter its melting point. The formation of oxides may or may not promote prompt fusion. In the case of pure tin and some of its alloys, a coating of oxide is often formed which retains the molten metal some time after the temperature of fusion has been pased, ultimate rupture occurring with considerable violence. On the contrary, the rapid oxidization of iron and copper wires seems to favor prompt fusion.

The question of low fusing point is one with which the fire underwriters are concerned, since wires fusing at high temperatures introduce an element of danger from fire. With fuses inclosed in properly constructed blocks, the danger from this source is not great, and the necessity of employing a metal of low melting point is not so important as might be imagined. Experience shows that fuses made of nearly all the metals available for such purposes will melt without dangerous scattering of particles or liberation of hot gases when the current is grad-

ually increased until the break occurs. This, however, is a condition which rarely obtains in practice. Mr. Preece experimented with various metals to determine their behavior on short circuit. He made for each metal a verbal description of the character of its fusion, such as: "Scintillating particles flew in all directions to a great distance." His results are unique and comprehensive as regards the variety of metals experimented with, but suffer from the inadequacy of the English language to express with proper shading the nature and degree of the disturbance in each case. The author of this memoir hit upon the plan of surrounding the fuse with a paper cylinder about 3½ inches in diameter and 10 inches in length, and then exploding the fuse by an excess of current. In this way a series of autographic records were obtained, showing with considerable accuracy what happened in each case. These records are, perhaps, more curious than valuable, but they are undeniably interesting, and it is to be regretted that some of them cannot be reproduced here. Owing to the cylindrical form of the paper, the particles of molten metal striking it, in any way but normally, traced out sinusoidal curves of continually decreasing amplitude. The vapors liberated colored the paper quite beautifully in many cases, and usually in characteristic tints, while an idea of the temperature attained was given by the degree to which the paper was burned. In most cases when one-half inch pieces were used an arc was established across the terminals, the intense heat of which was far more destructive than anything resulting from the temperature of the metal. The reader is referred to the original thesis for these records, as well as for much other matter pertaining to a subject which, it is believed, is too liable to be regarded of trivial importance.

What has been said will doubtless apply equally well to fuses on either direct or alternating current circuits, but in the latter case a new and annoying phenomenon, well worthy a special investigation, confronts the electrician. Reference is had to the subtle effect of the alternating current on fuse metals by reason of which they often yield when carrying currents well within their rated capacities. To cite a particular case: In the lighting system of the Cornell University Library eight 50-volt circuits were supplied with fresh fuses, and a record kept of their behavior for a period of three months. During this time it was found necessary to furnish six of the circuits with new fuses, one circuit requiring three such renewals. In this last case the fuse was badly corroded, owing to water dripping from the floor above. The others were in dry and airy places, the contact being bright and firm. One of the fuses had the appearance of being simply cut, the opening being so narrow as to require close examination to detect it.

In their attempts to study this peculiar effect of the alternating current, the chief difficulty encountered by the experimenters was the fact that their reports had to be submitted in a comparatively short time. The subject is peculiarly one requiring long periods in which the action, whatever its nature, may proceed far enough to yield results of definite and quantitative value.

For the purpose of systematic investigation it was assumed that the effects of the current might be one or more of the following:

(a) A change in the resistance of the metal. It was thought that this would likely be a rise, with a result of lowering the value of the fusing current.

(b) A change in the physical properties of the metal. It was thought possible that a molecular change, such as crystallization, might take place, caused by alternate contraction and expansion from the heating effects of a varying current.

(c) Poor contact. This might be due to the loosening of the binding screws or other holding device, because of the frequent alternations. Imperfect contact due to electrolytic action would be more likely to occur with direct than with alternating currents.

(d) The effect of the current upon various metals and alloys was thought likely to be different, and consequently some alloys might be of just the right composition to overcome most of the difficulties mentioned.

The following results deal particularly with, and tend to corroborate, the first and second assumptions:

Samples of wire of various rated capacities were obtained from four different manufacturers, and of this wire 14 pieces were chosen for use in the tests. Pieces of wire from each sample, varying in length from 2 to 10 feet, were wound into helices and mounted on wooden blocks. The ends were soldered to copper terminals of negligible resistance, the metal itself being used as a solder, and resin as a flux. The joints were allowed to stand at least twenty-four hours before any measurements of resistance were taken. For the determinations of resistance, a "fall of potential" method was chosen, as being best adapted to these small values. The standards used were a one-ohm coil standardized at Cavendish Laboratory in 1885, and a smaller compensated resistance composed of copper and carbon, accurately tested and compared with the standard coil.

After the fuses were mounted as above described, their resistances were found, and they were placed on the circuits available in the laboratory as follows:

Nos. 1 to 6 inclusive.	Alternating	~ = 250.
" 7 " 9	"	"	~ = 132.
" 10 " 14	"	Direct	——

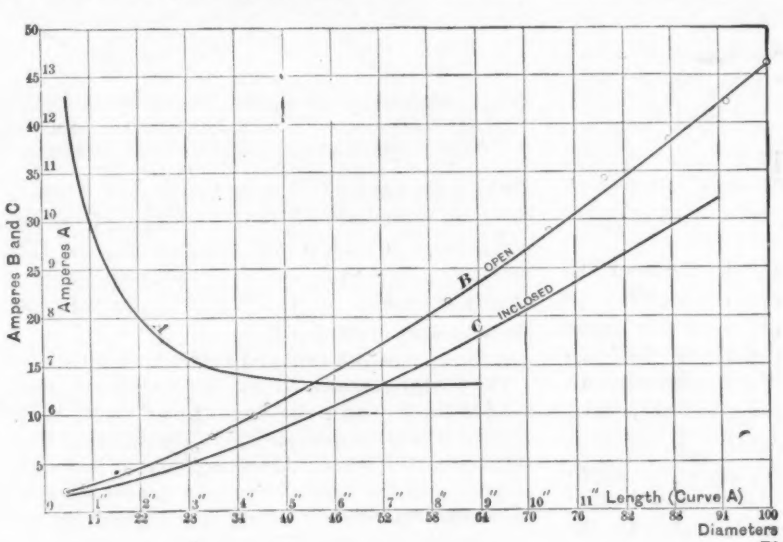
These fuses were subjected to the action of the current for periods ranging from 83 to 487 hours—this variation being due to the fact that the circuits were used intermittently for lighting and for general laboratory purposes. From time to time additional resistance measurements were made, and indicate that a distinct rise in resistance occurred in all of the fuses on alternating circuits except No. 6, which shows a somewhat anomalous behavior. The maximum rise occurred in the case of No. 8, amounting to 29.6 per cent. in 105 hours. Of the fuses on direct current circuits, all but one showed a slight decrease in resistance, the maximum change being only 3.5 per cent. The figures for each specimen appear in a succeeding table.

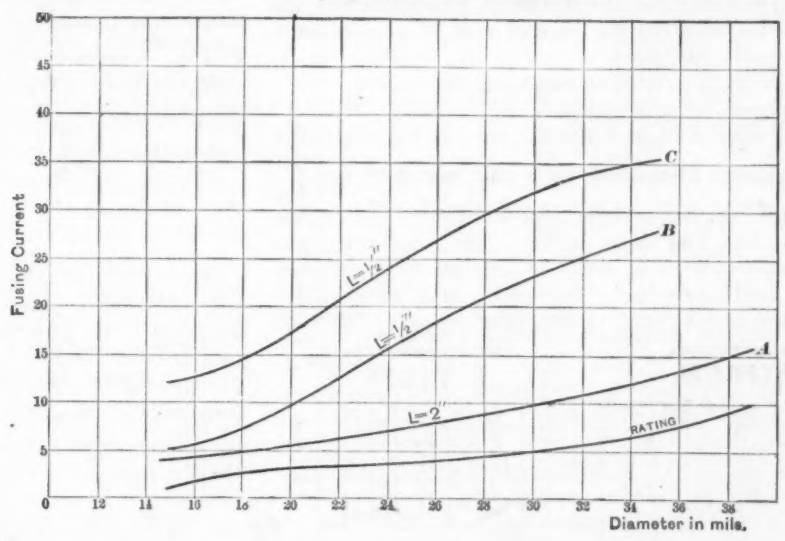
That some molecular change actually took place was shown in the following way: It being practically impossible to test wires of so soft material for tensile strength, it was considered best to subject them to an alternate torsional stress of a given amount, continuing the alternations and noting the number until the specimen gave way. A simple piece of apparatus was constructed for this purpose, and it did its work very well. Twenty pieces of each of the 14 specimens were tested in this way. Ten of these had been subjected to current action, and 10 had not. The change in brittleness in the case of the fuses which had been on alternating circuits was quite marked, being in no case less than 7 per cent.; while the change in those which had been on direct circuits was, with one exception, negligible. These results, together with some data on the fusing points before and after the passage of the currents, are given in the subjoined table:

No.	Rated capac.	Fusing current. Before.	After.	Per cent. ch'nge.	Torsion test. Before.	After.	Per cent.	Hours run.	Per cent. change resist.
1	2	8 83	8.56	3.06	14.4	10.9	24	487	.2
2	2	7.96	7.86	1.26	21.6	19.9	7.9	169	.5
3	3	12 6	12.15	3.56	14.9	13.2	11.14	487	15
4	3	8.46	8.24	2.6	28.8	22.4	21.4	169	.4
5	5	17.96	17.46	2.55	21.7	18.5	14.8	170	2.2
6	10	27.4	25.3	8.3	13.3	11 7	12	487	2
7	18	52	46.4	10 8	14.8	11	26.4	209	11.3
8	36	52	45.4	11.9	15.2	13.6	10.5	105	29.6
9	18	52	49.5	4.8	16.9	13.9	17.8	83	3.5
10	10	26.8	26.8	.3	24.1	23.9	.8	170	— 2.9
11	18	52	51.5	.9	13.8	13.7	.7	200	— 3.5
12	18	52	51.4	1.1	13.8	12.3	10	296	— .1
13	25	65.06	65.02	.061	11.1	11	.9	300	— 2.3
14	25	65.06	65	.092	11 4	11.3	.8	264	— 1.5

While these results may be considered as only a beginning along a line of work which is of both theoretical interest and practical value, yet they would seem to warrant the following conclusions:

(1) There is a distinct although irregular rise in the resistance of a fuse on an alternating circuit. (2) This is perhaps to be accounted for by a change in the molecular structure of the metal. (3) This results in a decided lowering of the fusing current, in some cases at least, easily sufficient to affect the reliability of the fuse.





FIGS. 1 AND 2.

Dynamo Graphics.*

BY ARTHUR H. ALLEN.

In calculating the shunt winding of dynamos whose carcass dimensions are known, the formulæ—

$$M A = \frac{E \times 60 \times 10^8}{N \times T},$$

$$A t = .315 \times M A \times \frac{l}{S . \mu},$$

$$A = \frac{.7854 \times .946 \times P \times A t}{E \times 10^6},$$

in which the notation

M A = Total magnetic flux through armature,
E = E. M. F. of armature at no load,
N = Revolutions per minute,
T = Total turns on armature periphery,
A t = Ampère turns required,
l = Length of one component of magnetic circuit in inches,
S = Section of ditto,
μ = Permeability of ditto,
A = Section of shunt wire in square inches,
P = Mean perimeter of shunt winding

is employed, are constantly in use, the second one most of all. Much time and trouble may be saved by employing diagrams to effect these calculations, on the principle used by Mr. Carl Hering in his wiring table, and already applied by Mr. A. T. Snell to the first mentioned formula.

The diagrams here shown are on a scale too small for accurate calculations; but when carefully drawn down about our times as large they may be relied on to give results averaging within 0.2 per cent. of the exact values, a sufficiently good approximation for most purposes.

It will be seen that the air gap diagram is invariable; that for iron, however, must be drawn to suit the permeability curves of the particular brands of iron in use. In the examples shown, the permeability curves were, for convenience, taken from "Munro and Jamieson's Pocket Book."

The shunt-winding formula, due to Mr. Carl Herring, is independent of length and depth of winding space; the constant .946 is correct for 98 per cent. conductivity copper at a final temperature of 100 degrees Fahr.

In order to explain the method of using the diagrams, it will be most convenient to fully work out an example, assuming average values and dimensions.

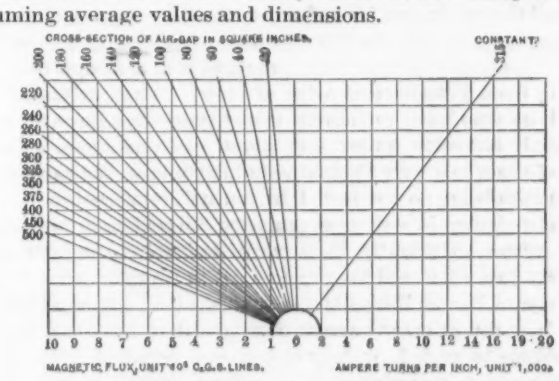


FIG. 1.—DYNAMO GRAPHICS.

Required, the shunt winding of a dynamo to the following data:

160 turns on armature periphery;
105 volts at terminals, at
600 revolutions per minute.
Leakage coefficient, 1.25.
Mean perimeter of shunt winding, 40 inches.

	Armature.	Field.	Air gap.
Cross-sectional area	70	100	240 sq. ins.
Magnetic mean length	15	60	1.25 ins.

$$\text{Then armature flux} = \frac{105 \times 10^8 \times 60}{160 \times 600}$$

$$= \text{about } 6.60 \times 10^6 \text{ C. G. S. lines.}$$

$$\text{Field magnet flux} = 6.6 \times 10^6 \times 1.25$$

$$= 8.25 \times 10^6 \text{ C. G. S. lines.}$$

On diagram No. 1, left of base line, find 6 6; follow the ordinate to meet the line marked 240; from the point of intersection pass along the abscissa to cut the slanting line in the right-hand compartment, and thence drop to the

* From the *Electrical Review* (London).

base line, where the value, 8,700 ampère turns per inch, is read off.

Then $8{,}700 \times 1.25 = 10{,}870$ ampère turns for air gap.

Next, take 6.6 in same place on diagram No. 2. Proceed vertically to meet the line marked 70, thence horizontally

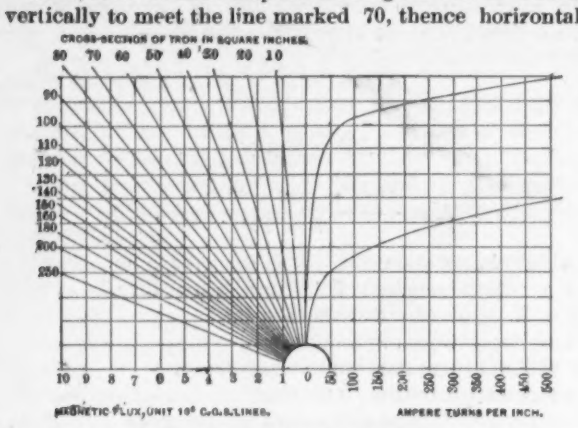


FIG. 2.—DYNAMO GRAPHICS.

to the permeability curve for wrought iron, and vertically down to the base line at 45 ampère turns per inch.

$45 \times 15 = 675$ ampère turns for armature.

Assuming that the field magnet iron is of the same quality as that used for the armature, substitute 8 25 for 6.6 in the last case, 100 for 70, and read 23 ampère turns per inch on the base line.

$23 \times 60 = 1{,}380$ ampère turns for fields.

Total ampère turns = 10,870 + 675 + 1,380 = 12,925.

Turning now to diagram No. 3, it is evident that 13,000 is beyond its scope; but divide by 2 and read 6.45 $\left(=\frac{12.9}{2}\right)$ on left base line, follow up to meet the 40-inch line, across to 105 volt line, and down to base line. The reading is .00185 square inch; this must be doubled for 12,900, and becomes .0037 square inch. The wire corresponding to this is .0686 inch in diameter, or .0608 inch square. This wire

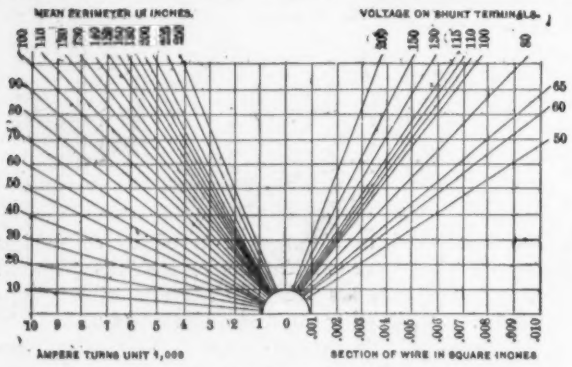


FIG. 3.—DYNAMO GRAPHICS.

will be found to give very nearly 12,900 ampère turns, whatever the length and depth of winding space, provided that the voltage and mean perimeter are correct as above, and that the working temperature is about 100 degrees Fahr.

It is easy to add another quadrant to Nos. 1 and 2, to perform the operation of multiplying the ampère turns per inch by the length of the magnetic circuit, but this doubles the size of the diagrams and renders them unhandy, without being of much advantage.

Theory of the Transformer.*- -IV.†

BY F. BEDELL AND A. C. CREHORE.

In the preceding paper the transformer diagram was established upon an analytical basis, and it was shown how to find the electromotive force that must be impressed upon the primary in order to drive an assumed primary current. But this alone is of very little practical use, although interesting from a theoretical point of view. What is wanted by those who have to handle transformers is a knowledge of their behavior under any given circumstances. The transformer is a very sympathetic instrument, the variable quantities being so connected in mutual relationship that a slight change in any one quantity immediately affects the others. Evidently it is very desirable to be able to predict just what will happen in a given transformer when any one of its conditions is changed—to find, for example, just how the primary current changes when the secondary resistance is varied, or how the power required changes with such a variation. When these questions are answered, it will be easy to see, by means of the diagrams, just what conditions are necessary for good regulation; why a natural transformation is from constant primary potential to constant secondary potential, or from constant primary current to constant secondary current.

The transformer diagram will enable us to answer most of these questions. It is proposed to treat the subject as a series of problems and to first consider the variation of the quantities when the secondary resistance is changed, there being no self-induction in the secondary circuit external to the transformer itself.

PROBLEM I.—The primary current is maintained constant, while the secondary resistance alone is varied. It is required to find how all the other quantities are affected.

A.—THE SECONDARY ELECTROMOTIVE FORCES.

Referring to Fig. 5, we find reproduced the transformer diagram given in Fig. 4 of the previous article. The same letters here designate the corresponding points in Fig. 4, and, in general, throughout all the diagrams which follow the letters in Fig. 4 are used to designate the corresponding points in the new figure.

$\overline{O\,A}$ is the constant primary current which is given; $\overline{O\,B} = M\,\omega\,I_1$ is the E. M. F. impressed upon the secondary, and is therefore a constant independent of any variation of secondary resistance.

Since the secondary E. M. F. triangle O B C is a right triangle, always having $\overline{O\,B}$ for its hypotenuse, the locus of the point C is the semi-circle O C B, for any variation in the secondary resistance. $\overline{O\,C}$ is always a chord of this circle equal to $R_2\,I_2$, the effective E. M. F. in the secondary. $\overline{C\,B}$ is the E. M. F. to overcome the self-induction, and is equal to $L_2\,\omega\,I_2$. The point C moves in the direction indicated by the arrow as the secondary resistance increases.

B.—THE SECONDARY CURRENT.

The secondary current $\overline{O\,D}$ is always in the direction of the effective E. M. F. $\overline{O\,C}$ and equal to it divided by R_2. It is proved on page 223 of the writers' "Alternating Currents" that the locus of D, as the resistance varies, is the semi-circle O D L upon $\overline{O\,L}$ as a diameter. The magnitude of $\overline{O\,L}$ is $\frac{E_2}{L_2\,\omega} = \frac{M}{L_2}\,I_1 = \frac{S_1}{S_2}\,I_1$ and is independent of the secondary resistance. This may be shown as follows: Draw from D a line perpendicular to $\overline{O\,D}$ and let it intersect $\overline{O\,A}$ produced in L. It will always intersect at L, a constant distance from O; for, in the right triangle O D L the angle $D\,L\,O = \theta_2$, and $\overline{O\,L}\sin\theta_2 = \overline{O\,D}$. Or,

$$\overline{O\,L} = \frac{\overline{O\,D}}{\sin\theta_2} = \frac{I_2}{\sin\theta_2} = \frac{I_2}{\frac{L_2\,\omega\,I_2}{E_2}} = \frac{E_2}{L_2\,\omega} = \frac{M}{L_2}\,I_1$$

$$= \frac{S_1}{S_2}\,I_1\,. \qquad (47)$$

Hence as $\overline{O\,L}$ is independent of R_2, the locus of the secondary current is a semi-circle O D L upon $\overline{O\,L}$ as diameter. The direction of the arrow upon any curve indicates the direction of motion of the point as the independent variable increases. Even if the ohmic resistance were nil, the current has a finite value equal to $\overline{O\,L}$, in a direction just opposite the primary current $\overline{O\,A}$. This is the direction of the current when the secondary is short-circuited; as the secondary resistance is increased, the current $\overline{O\,D}$ moves in the semi-circle as indicated by the arrow.

C.—THE BACK ELECTROMOTIVE FORCE.

Since the back E. M. F. $\overline{O\,F}$, is always equal to $M\,\omega\,I_2$ and is 90 degrees behind the secondary current, its locus must be similar to that of the secondary current, and 90 degrees behind it; that is, it must be a semi-circle having its diameter 90 degrees behind $\overline{O\,L}$, and consequently in the opposite direction to the secondary impressed E. M. F. $\overline{O\,B}$. The diameter of the back E. M. F. circle must be equal to M ω times $\overline{O\,L}$, that is, equal to $\frac{M\,E_2}{L_2}$. If we assume that there is no magnetic leakage, and that there is no external self-induction in the secondary, we have the relation $M^2 = L_1\,L_2$ (see equation 13), and the diameter $\overline{O\,M}$ of the semi-circle of the back E. M. F. may be expressed,

$$\overline{O\,M} = M\,\omega \times \overline{O\,L} = \frac{M\,E_2}{L_2} = \frac{M^2\,\omega\,I_1}{L_2} = L_1\,\omega I_1. \quad (48)$$

Hence it appears that the back E. M. F. approaches in magnitude the primary E. M. F. of self-induction $L_1\,\omega\,I_1$, but is in the opposite direction so as to neutralize it when the secondary is short-circuited. This will be more evident after we have considered the primary E. M. Fs.

D.—THE PRIMARY ELECTROMOTIVE FORCES.

The component of the primary E. M. F. needed to overcome the primary resistance, viz., $\overline{O\,H} = R_1\,I_1$, remains constant independent of the secondary resistance; and the component to overcome the primary self-induction $L_1\,\omega\,I_1$ is also independent of R_2.

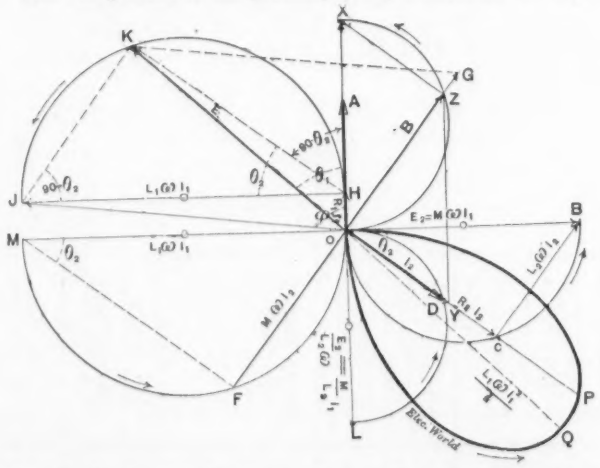


FIG. 5.—CONSTANT CURRENT POLAR DIAGRAM SHOWING THE VARIATION OF THE QUANTITIES AFFECTED AS THE SECONDARY RESISTANCE CHANGES.

The only component of the primary E. M. F. that changes with the secondary resistance is, therefore, that to overcome the back E. M. F. When this component, $\overline{O\,G}$, equal and opposite to $\overline{O\,F}$, is added to the constant line $\overline{O\,J}$, which is the resultant of $\overline{O\,H}$ and $\overline{H\,J}$, we find that the primary E. M. F. $\overline{O\,K}$ lies upon a semi-circle H J K similar but opposite to the back E. M. F. circle, and with $\overline{H\,J}$ as its diameter. When the secondary is short-circuited and R_2 is very small, the point F approaches M, and K approaches H, so that the only primary E. M. F. needed is merely enough to overcome the ohmic resistance. The back E M. F. here counteracts that of the primary self-induction as before explained.

E.—THE RESULTANT MAGNETIZATION.

The variation in the resultant magnetization $\overline{O\,Z}$ is easily found; for, the point Z must always be the right angle of

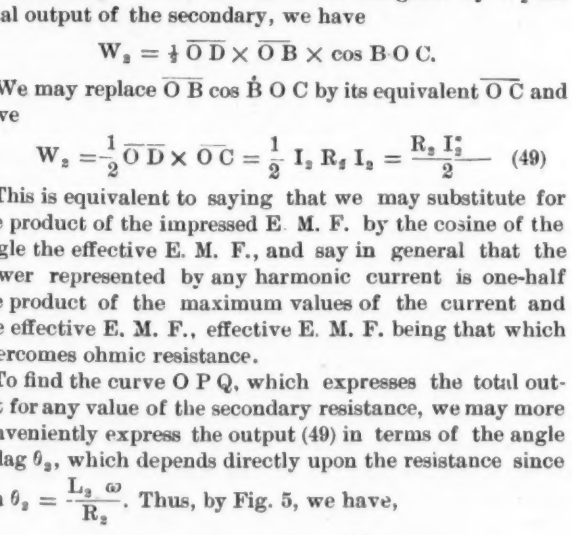


FIG. 6.—CONSTANT CURRENT POLAR DIAGRAM SHOWING THE SECONDARY TOTAL, EXTERNAL AND INTERNAL WATT CURVES AS THE SECONDARY RESISTANCE VARIES.

the triangle having $\overline{O\,X}$ as its hypotenuse. Since $\overline{O\,X}$ is a constant, independent of any variation of the secondary resistance, it is evident that the magnetization $\overline{O\,Z}$ always lies upon a semi-circle O Z X for any variation in the secondary resistance. It is always 90 degrees in advance of the secondary current $\overline{O\,D}$.

F.—THE SECONDARY TOTAL OUTPUT.

The energy represented by the secondary current is expended partly within the transformer itself, being transformed into heat, and partly in the external line, in the form of useful work. If we include in the term "total output" both the internal and the external energy, we may calculate it as follows: The power represented by any harmonic current such as $\overline{O\,D}$, Fig. 5, is found by taking one-half the product of the maximum value of the current by the maximum value of the impressed E. M. F. by the cosine of the angle between them. The impressed E. M. F. upon the secondary is $\overline{O\,B}$; hence, if we designate by W_2 the total output of the secondary, we have

$$W_2 = \tfrac{1}{2}\,\overline{O\,D} \times \overline{O\,B} \times \cos B\,O\,C.$$

We may replace $\overline{O\,B}\cos\dot{B}\,O\,C$ by its equivalent $\overline{O\,C}$ and have

$$W_2 = \frac{1}{2}\,\overline{O\,D} \times \overline{O\,C} = \frac{1}{2}\,I_2\,R_2\,I_2 = \frac{R_2\,I_2^2}{2} \quad (49)$$

This is equivalent to saying that we may substitute for the product of the impressed E. M. F. by the cosine of the angle the effective E. M. F., and say in general that the power represented by any harmonic current is one-half the product of the maximum values of the current and the effective E. M. F., effective E. M. F. being that which overcomes ohmic resistance.

To find the curve O P Q, which expresses the total output for any value of the secondary resistance, we may more conveniently express the output (49) in terms of the angle of lag θ_2, which depends directly upon the resistance since $\tan\theta_2 = \frac{L_2\,\omega}{R_2}$. Thus, by Fig. 5, we have,

$$\overline{O\,D} = \overline{O\,L}\sin\theta_2\,;\ \text{or}\ I_2 = \frac{M}{L_2}I_1\sin\theta_2\,;$$

and $$\overline{O\,C} = \overline{O\,B}\cos\theta_2\,;\ \text{or}\ R_2\,I_2 = M\,\omega I_1\cos\theta_2.$$

Combining these expressions according to (49) we find

$$W_2 = \frac{M^2\,\omega\,I_1^2}{4\,L_2}\sin 2\,\theta_2 = \frac{L_1\,\omega\,I_1^2}{4}\sin 2\,\theta_2. \quad (50)$$

By this equation it appears that the curve O P Q for the total output has the form of a loop symmetrical with respect to a line O Q bisecting the angle BO L. The maximum value of W_2 occurs when $\sin 2\,\theta_2 = 1$ or when $\theta_2 = 45°$ and $\overline{OQ}$ is therefore equal to $\frac{L_1\,\omega\,I_1^2}{4}$. At this point the $\tan\theta_2 = \frac{L_2\,\omega}{R_2} = 1$. Hence the value of the secondary resistance to make the total output a maximum is $R_2 = L_2\,\omega$.

THE SECONDARY EXTERNAL OUTPUT.

If we desire to express the external output of the transformer alone, we may subtract from the total output that part which is lost in the transformer itself. Fig. 6 illustrates this point. It is merely a repetition of a part of Fig. 5 showing the total watt curve as before; but now there are two additional curves, the internal and external watt curves respectively, the sum of which equals the total watt curve. If we call that part of the secondary resistance which is within the transformer R_t and that which is external to it R_e, we have the total output made up of two parts, viz.:

$$\frac{1}{2}\,R_2\,I_2^2 = \frac{1}{2}\,R_t\,I_2^2 + \frac{1}{2}\,R_e\,I_2^2\,; \qquad (51)$$

$$\text{or,}\ W_2 = W_t + W_e.$$

When we vary the resistance R_2 we will suppose that

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† For the preceding section of this article see THE ELECTRICAL WORLD, May 6, 1893, p. 339.

the external resistance alone changes, while the transformer resistance remains constant. As it was found more convenient in the case of the total output to express it in terms of θ_2, so now we write W in terms of θ_2.

$$W_t = \frac{1}{2} R_t I_2^2; \qquad (52)$$

and since $I_2 = \frac{M}{L_2} I_1 \sin \theta_2$ (see Fig. 5), we have

$$W_t = \frac{M^2 R_t I_1^2}{2 L_2^2} \sin^2 \theta_2 = \frac{L_1 R_t I_1^2}{2 L_2} \sin^2 \theta. \qquad (53)$$

By this equation it appears that the power expended within the transformer is directly proportional to the square of the sine of the angle of lag, since the coefficient $\frac{L_1 R_t I_1^2}{2 L_2}$ is independent of the external resistance. When $\theta_2 = 90°$, the power is a maximum equal to the coefficient above, and is represented by $\overline{O T}$ in Fig. 6. At 60 degrees it is $\frac{3}{4}$, at 45 degrees it is $\frac{1}{2}$, and at 30 degrees it is $\frac{1}{4}$ of the maximum value.

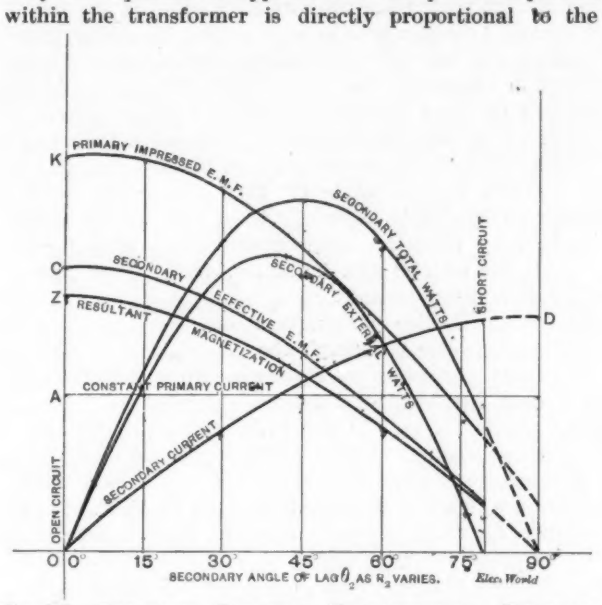

FIG. 7.—CONSTANT CURRENT RECTANGULAR DIAGRAM SHOWING THE RELATION BETWEEN THE MAGNITUDES OF THE VARIOUS QUANTITIES AFFECTED AND THE ANGLE OF LAG θ_2 AS THE SECONDARY RESISTANCE VARIES.

The external watt curve O S may be found by subtracting at every point from the radius of the total watt curve O P Q the corresponding radius of the internal watt curve O P T. This curve naturally is the one which it is desirable to investigate, since it expresses the useful energy which can be taken from the transformer. Its equation may be found by the same principle by which we are enabled to draw the curve and is thus derived: Subtracting (53) from (50).

$$W_e = W_2 - W_t = \frac{L_1 \omega I_1^2}{2} \left\{ \frac{1}{2} \sin 2\theta_2 - \frac{R}{L_2 \omega} \sin^2 \theta_2 \right\}$$

Replacing the square of the sine by its equivalent, $\frac{1 - \cos 2\theta_2}{2}$, (54) becomes

$$W_e = \frac{1}{4} L_1 \omega I_1^2 \left\{ \sin 2\theta_2 + \frac{R_t}{L_2 \omega} \cos 2\theta_2 \right\} - \frac{L_1 R_t I_1^2}{4 L_2}.$$

This may be simplified by the general formula

$$A \sin \theta + B \cos \theta = \sqrt{A^2 + B^2} \sin \left\{ \theta + \tan^{-1} \frac{B}{A} \right\} \qquad (55)$$

and written

$$W_e = \frac{L_1 I_1^2}{4 L_2} \left[\sqrt{R_t^2 + L_2^2 \omega^2} \sin \left\{ 2\theta_2 + \tan^{-1} \frac{R_t}{L_2 \omega} \right\} - R_t \right]. \qquad (56)$$

This equation enables us to see the nature of the external watt curve. When $\theta_2 = 0$, that is, when $R_e = \infty$ and the transformer is open circuited, there is evidently no secondary current, and it is seen that W_e reduces to zero; for, $\sin \left\{ 2\theta_2 + \tan^{-1} \frac{R_t}{L_2 \omega} \right\}$ becomes $\sin \tan^{-1} \frac{R_t}{L_2 \omega} = \frac{R_t}{\sqrt{R_t^2 + L_2^2 \omega^2}}$, and this multiplied by the coefficient $\sqrt{R_t^2 + L_2^2 \omega^2}$ reduces the first term in the parenthesis of (56) to R_t, and the parenthesis itself consequently to zero. Again when the transformer is short circuited, the external resistance is practically reduced to zero, and θ_2 must have the maximum value attainable. This value of θ_2 should reduce the external work again to zero, since the external resistance is zero. The largest value which $\tan \theta_2$ (being equal to $\frac{L_2 \omega}{R_e + R_t}$) can have is evidently $\frac{L_2 \omega}{R_t}$, found by making R_e zero.

This value, substituted in (56), reduces the sine to

$$\sin \left\{ 2 \tan^{-1} \frac{L_2 \omega}{R} + \tan^{-1} \frac{R_t}{L_2 \omega} \right\}$$

which easily reduces to

$$\frac{R_t}{\sqrt{R^2_t + L_2^2 \omega^2}}.$$

Substituting in (56) we see that W_e becomes zero for this value of θ_2. This angle is determined in Fig. 6 by the point P, where the internal and the total watt curves intersect, since here, by subtracting the internal from the total radius, we necessarily make the radius vector of the external watt curve zero at this point. The angle B O D is, therefore equal to $\tan^{-1} \frac{L_2 \omega}{R_t}$, and L o D is $\tan^{-1} \frac{R_t}{L_2 \omega}$. $\overline{O D}$ is the largest secondary current attainable, and $\overline{O C}$ is the effective E. M. F. at this point.

To find when W_e a maximum, we have to make the sine in (56) become unity; that is, we must put

$$2\theta_2 + \tan^{-1} \frac{R_t}{L_2 \omega} = 90°, \text{ and consequently find}$$

$$\theta_2 = 45° - \tfrac{1}{2} \tan^{-1} \frac{R_t}{L_2 \omega} = 45° - \tfrac{1}{2} \text{ L O D.} \qquad (57)$$

This shows that the value of θ_2, viz., B O S, Fig. 6, which makes W_e a maximum brings $\overline{O S}$ in advance, by an angle equal to $\frac{1}{2}$ L O D, of the maximum value $\overline{O Q}$ of the total watt curve. Equation (56) shows that the external watt curve is of the same nature as the total watt curve, both being in the form of a loop. The total curve has its two tangents at the origin at right angles to each other, and is symmetrical with respect to a line $\overline{O Q}$ which bisects this angle. The external curve has its tangents at the origin, making an angle, B O D, with each other, and is symmetrical with respect to a line, $\overline{O S}$, which bisects this angle. The points of difference are that the external curve has its line of symmetry thrown in advance of the total curve, and at the same time the tangents at the origin make an angle with each other less than 90 degrees.

DIAGRAMS WITH RECTANGULAR CO-ORDINATES.

Each of the quantities whose variation we have already followed by means of the polar diagram may be represented by means of the orthodox rectangular diagram if we choose to sacrifice the advantage gained in the polar diagram of seeing the angles between the various quantities concerned, and care merely to know the relation between the magnitudes of quantities under consideration.

Thinking that it may be an additional advantage to see the variation of the quantities concerned, both in the polar diagram and in the Cartesian diagram, we add the equivalent rectangular diagrams which show the variation in magnitude only of the quantities already considered in Fig. 5. In Fig. 7 the abscissas represent the angles of lag, θ_2, in the secondary as the resistance varies. The cotangent of the angle of lag varies directly as the resistance, so that if the resistance is known for one angle it may be calculated for any other. In Fig. 8, the abscissas are the secondary resistances. The ordinates in every case are indicated by the name written on the curve in question. The construction of the curves in Figs. 7 and 8 is made directly from the polar diagram Fig. 5.

To construct the curves in Fig. 7 proceed as follows: Lay off equal spaces on a horizontal axis to represent angles of secondary lag, θ_2. Suppose it is desired, for instance, to represent the secondary effective E. M. F. in this diagram. Referring to the polar diagram, Fig. 5, we see that the effective E. M. F., $\overline{O C}$, always lies upon the semi-circle O C B. From the origin O draw radii vectors at equal intervals, say every 15 degrees. The ordinates of the curve in Fig. 7 are the lengths of the various radii intercepted between the circumference of the semi-circle O C B and the origin O. Similarly the rectangular curves may be constructed by points for all the curves in the polar diagram.

It is noticeable that all these curves are sine curves in the rectangular diagram. This may be shown as follows: Consider the curve for secondary effective E. M. F. In the polar diagram we have

$$\overline{O C} = \overline{O B} \cos \theta_2 = \overline{O B} \sin (90° - \theta_2). \qquad (58)$$

This is the polar equation of the circle O C B. If we now plot this equation with rectangular co-ordinates it evidently is the sine curve, as the essential characteristic of the equation of a sine curve is that the dependent variable shall equal a constant times the sine or cosine of the independent variable. By equation (58), when θ_2 is zero the effective E. M. F. has its maximum value $\overline{O B}$, and it diminishes to zero at 90 degrees.

The resultant magnetization has a curve similar to the effective E. M. F., but differing, of course, in magnitude.

The primary current which is kept constant is represented by a horizontal line.

The secondary current $\overline{O D}$ has for its equation

$$O D = O \overline{L} \sin \theta_2 \qquad (59)$$

and is consequently a maximum at 90 degrees.

There is a limit indicated by the vertical dotted line labeled "short circuit" in the figure, beyond which these curves would not be used in practice inasmuch as the transformer is short-circuited before we reach the 90 degre point, and the total secondary resistance is never reduced absolutely to zero.

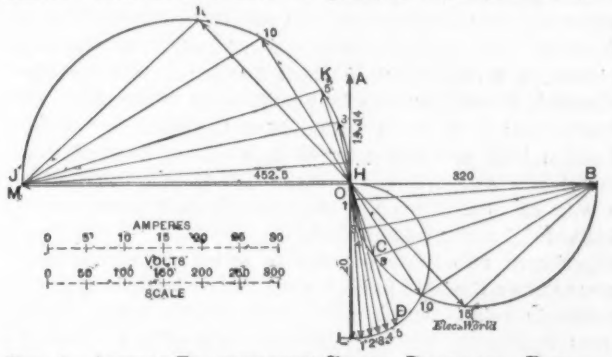

FIG. 9.—ACTUAL TRANSFORMER POLAR DIAGRAM. DATA—L_1 = .032 HENRY; L_2 = .016 HENRY; R_1 = .227 OHM; R_2 = .16 OHM; ω = 1,000. POINTS 1, 2, 3, ETC., DESIGNATE THE POSITIONS OF THE VECTORS WHEN THE SECONDARY RESISTANCE IS 1, 2, OR 3, ETC., OHMS.

Equation (50) gives the total output of the secondary. It starts at zero, reaching a maximum at 45 degrees, and returning to zero again at 90 degrees.

In order to draw the curves of Fig. 8, in which the abscissas represent the secondary resistances instead of the angles of lag, as in Fig. 7, suppose that, in the particular position of the lines as represented in the polar diagram ($\overline{O C}$, $\overline{O D}$, $\overline{O Z}$, and $\overline{O K}$, for example, Fig. 5), the corresponding secondary resistance is R_2. In the rectangular diagram (Fig. 8) erect ordinates $\overline{O C}$, $\overline{O D}$, etc., corresponding to this value of the secondary resistance R_2. Having once found one set of points, others are readily determined; for, if we double the resistance, for example, the tangent of the angle of lag becomes half as great, and the values of the ordinates for the angle which has its tangent half as great may be measured off from either the polar diagram, Fig. 5, or the rectangular one, Fig. 7. Thus all of the curves in Fig. 8 may be drawn by points. The dotted vertical line at the left of Fig. 8 corresponds to that at the right in Fig. 7, and represents the point where the secondary is short-circuited.

Figs. 9 and 10 are to illustrate the way in which the typical diagrams Figs. 5 and 8 appear in an actual case. The data for the transformer, which are sufficient to enable one to draw the figures, are given below each figure. The very long and thin primary E. M. F. triangle O H J, in Fig. 9, is to be noticed. The points 1, 2, 3, 4, 5, 10, 15 denote the positions of the various vectors when these are the values of the secondary resistances. It is because this primary E. M. F. triangle is so long and thin that the secondary current, $\overline{O D}$ is almost 180 degrees behind the primary E. M. F. $O \overline{K}$. This fact also makes the ratio of the primary E. M. F. $\overline{OK}$ to the secondary effective E. M. F. $\overline{O C}$ almost a constant ratio. The ratio would be constant if the points H and O coincided.

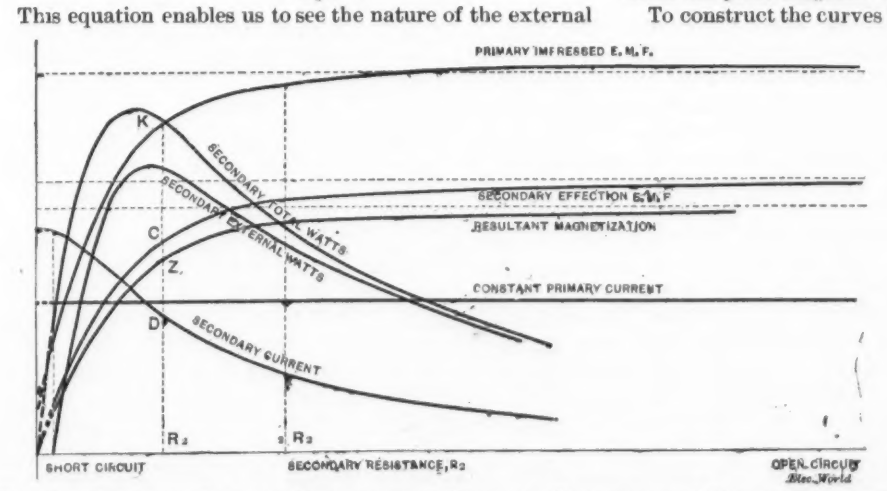

FIG. 8.—CONSTANT CURRENT RECTANGULAR DIAGRAM SHOWING THE VARIATION IN THE MAGNITUDE OF THE QUANTITIES AFFECTED AS THE SECONDARY RESISTANCE VARIES.

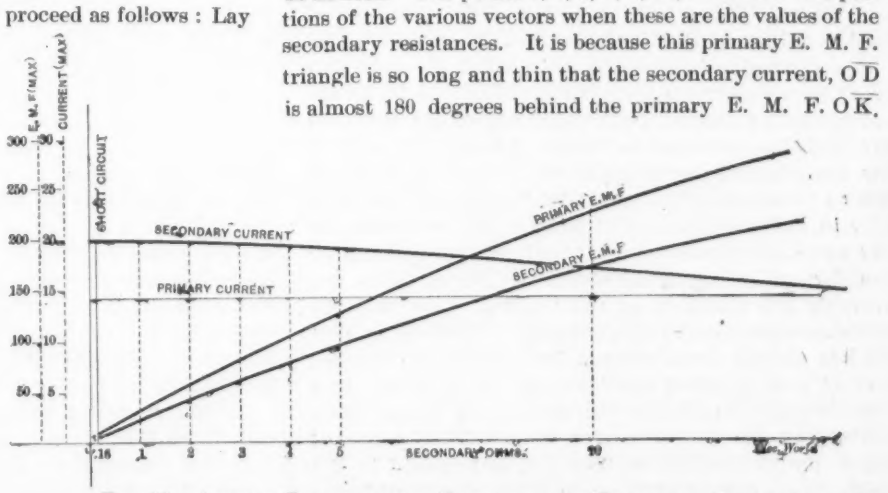

FIG. 10.—ACTUAL TRANSFORMER RECTANGULAR DIAGRAM. DATA—L_1 = .032 HENRY; L_2 = .016 HENRY; R_1 = .227 OHM; R_2 = .16 OHM; ω = 1,000.

Fig. 10 is drawn by means of the diagram, Fig. 9, in the same manner as 8 was drawn from 5, and it shows how nearly constant the secondary current remains for all loads for which the transformer is designed. When the secondary resistance is increased to 5 ohms, the secondary current falls from 20 to 19 ampères, and the output becomes $\frac{R_2 I_2^2}{2} = \frac{5 \times 19^2}{2} = 902.5$ watts. The transformer was designed to give an output of only 550 watts, so that within the output for which it is designed it transforms from a constant current to an approximately constant current.

(To be continued.)

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BY CARL HERING.

ELECTRO-PHYSICS.

Luminous Discharges in Electrodeless Vacuum Tubes.—An abstract of a paper by Mr. Rimington, read before the Physical Society, is given in the Lond. "Electrician," May 5, accompanied by a few illustrations. He states that luminous rings produced in vacuum tubes by discharging Leyden jars through coils surrounding them had been attributed by Tesla to the electrostatic action of the surrounding wire, rather than to the varying magnetic induction through the rarefied gases; the present author thinks that the latter cause is the chief one, but that a supersupposed electrostatic field greatly assists their production. An experiment was shown in which a tube was placed in a coil through which Leyden jars were discharged, the spark gap being adjusted to produce no luminosity; if then the terminals of the coil, that is the Leyden jars, are also connected to one or both of two metal plates between which the coil is placed, in such a way as to increase the electrostatic field through the bulb, bright rings immediately appeared. In another experiment two loops of wire in series were used and were put on the bulb in such a way as to produce a large magnetic effect but a small electrostatic field, bright rings appeared, while if the magnetic effects opposed each other and the electrostatic field was increased no rings were seen. The original paper treats this subject mathematically at some length; he shows that the time integral is roughly proportional to the fourth root of the capacity; large jars are therefore only slightly better than small ones. Mr. Trotter discussed the difference between these effects and those obtained by Swinton; the latter Mr. Rimington said were quite different and were due to different causes, namely to the phosphorescence of the glass.

Loss of Charge in Diffused and Obscure Light.—In a short note, read before the French Academy of Sciences, reprinted in "L'Ind. Elec.," April 25, and in the "L'Elec.," April 29, Mr. Branley states that the conductivity of gases depends less on their nature than on the conducting surfaces acting as electrodes. He made some observations with a goldleaf electroscope and obtained the following results: A disc of aluminium 6 inches in diameter connected to the terminal of the electroscope diffuses slowly both positive and negative electricity independently of the light surrounding it, but when polished the diffusion is rapid even in diffused light; when freshly polished and exposed to the blue light of the sky it disperses the whole charge (presumably about 400 volts) in seven seconds; with a disc of zinc it takes twenty seconds and with cadmium ninety-five seconds; the discharge becomes more rapid under the direct action of solar light; with copper, tin and brass the discharge is insignificantly small; if the discs are covered with a metallic box the loss is nearly nothing excepting only with discs of bismuth, in which the discharge is independent also of the condition (moist or dry) of the air or the degree of the polish.

UNITS, MEASUREMENTS AND INSTRUMENTS.

The Congress Proposals.—The "Elek. Zeitschrift," April 28, publishes a full translation of the proposals of the Amer. Inst. of E. E.'s Committee. It is prefaced by a brief discussion by the editor, in which he says that the proposals go much further than what should be the province of an International Congress; such a Congress may give specific names to units, but ought not to state how the physical quantities should be called, as terms such as "reluctance," "illumination," voltage," etc., may differ in different languages; he says the proposals appear more like those for an American Congress rather than for an International Congress. He criticises unfavorably the adoption of the "violle." (It will be noticed, however, that no such proposal was made, as that unit has already been adopted by a previous congress; whether that adoption should be approved or not is a question which it might be well to discuss.) He criticises unfavorably the adoption of a standard resistance of copper (no such adoption, however, is proposed in the report, which merely proposes to define the Matthiessen standard and has no reference to the question whether this standard is the normal resistance of copper or not); he suggests that the specific resistance of various qualities suggests that the specific resistance of various qualities of copper is best referred to the specific resistance of mercury (a suggestion which appears to be commendable as it settles the much vexed question of a standard specific resistance of copper). A discussion at the German Electrical Society has already taken place and is promised in a subsequent issue.

Units.—The "Elek. Zeitschrift," May 5, publishes at some length an article under the title of "proposals for the legal definition of electrical units" taken apparently from a report of the Imperial Physical-Technical Institute of Germany. It discusses the subject of the practical electrical units and defines them in practically the same terms as in the report of the British Board of Trade, which report has been given in full in these columns. The conclusions reached are contained in the American Institute's proposals for adoption at the Congress. The article is well worth the attention of those interested in this subject.

Portable Wattmeter.—"L'Ind. Elec.," April 25, describes and illustrates a new portable wattmeter made by Ganz & Co. The deflection of the fine wire coil is brought back to zero by means of a torsional spring, the amount of torsion being measured. It is capable of measuring from two to 250 amperes at 50 to 150 volts with an error of not more than 2 to 3%. As the coefficient of self-induction is appreciable it is necessary to determine a constant for every type of machine with which it is used, and it cannot be used with currents having a considerable lag; the heating of the coil is not negligible.

DYNAMOS, MOTORS AND TRANSFORMERS.

Alternating Current Motor.—The discussion of Mr. Snell's paper, mentioned before in these columns, is given at some length in the Lond. "Electrician," May 5. Mr. Sparks, in behalf of Mr. Brown, showed a synchronous and a non-synchronous motor in action, both for a frequency of 40; the non-synchronous motor was started by placing the armature and field magnets in parallel, with a fixed resistance in series with the field, the current being supplied through a choking coil; when in the proper position it starts, when run on a loose pulley; the choking coil was then gradually cut out; finally the field magnets were cut out all together, and then connected in parallel with a few turns of one armature coil; after reaching synchronism the load can be thrown on suddenly and can be increased to even three times its rated load. He gives some figures for a non-synchronous motor of one horse power, and compares them with similar figures of a Dobrowolsky three-phase motor, which comparison shows an advantage in every feature in favor of the Brown motor. Such motors are about being introduced in a large number of cities on the continent. Mr. Swinburne claimed to be the inventor of a motor shown by Brown. He called attention to the fact that the motor was built for a low frequency and would not work well for high frequencies; he thought there was little use, in England, of a motor for such a low frequency. The non-synchronous motor shown, he thought, was due to Messrs. Hutin and Le Blanc; he thinks the alternating motor problem would never be solved until a motor was self-exciting, instead of exciting by the reaction of one part on the other; he thought there was a great deal too much being said in favor of double and triple phase currents; what the engineer wants to-day is a motor which will run on existing alternating currents; if an installation consisted entirely of motors it might pay to use double and triple phase currents. He proposed defining the field as the part of the machine which had the induction in the iron constant, and the armature as that part where the alternating current was; this would agree with direct current machines in which the current in the armature was really alternating. This Prof. Ayrton claimed to have suggested as early as 1881, which he now suggested modifying by calling the field the part where it varied least and the armature that in which it varied most; he thought it would pay the company to supply power at two to four cents per kilowatt less for alternate current motor work in order to compensate for any want of efficiency in such motors; the small disadvantage of the inefficiency of such motors was really not worth considering. He said it was not true that the output per weight was less in the three-phase system than in the two-phase. Mr. Mordey stated that there was a disposition to go down to a frequency of 40 to 50; he thinks that in going down to 20, 30 or even 40 the disadvantages of alternating currents were so great that little could be said in their favor in comparison with direct currents; the real reason why such low frequencies were used on the continent he thought was due to the difficulty in designing machines; to make a transformer equally good and efficient at low frequencies was very difficult as they were not only costly but more wasteful; it was not a mere question of design; he found that a transformer designed for 40 periods was much more efficient at 100, while one made for 100 was burnt up at 40; he thinks this shows that there is no truth in the statement that transformers could be equally well designed for any period; what applied to transformers would, he believed, be found to apply to motors also.

New Multiphase System.—Under this heading in the "Elek. Zeitschrift," May 12, Mr. Kratzkart gives a vague and unsatisfactory description of what he terms a new system, presumably invented by himself. Although accompanied by nine cuts the description is so indefinite and incomplete that it is difficult to understand what the author means. It appears that the armature and magnets consist of two, three, or more short-circuited windings, to which the currents are led at four or more diametrically opposite points; it appears that the magnet and armature coils for each one of the circuits are connected in multiple or in series with each other, and that the current is led to the moving part by means of brushes; both the moving and the fixed part, that is the so-called field and armature, receive current from the line; for a three-phase system there are three contact rings and three line wires. He says it is distinguished from the Tesla, as also from all the other multiphase motors (of which he names a long list), in that in the Tesla motor the current of each phase flows through the separate armature coils in series, while in his it flows in a "closed circuit in multiple" (presumably as in a direct current armature); in the Tesla motor the two ends of the circuit are next to each other, while in his they are diametrically opposite; in the Tesla motor the coils for the different phases are next to each other, in his they are over each other or next to each other. He states that his motor can also be run with an ordinary alternating current, in which case the current is divided at the motor into two or more parallel branches having different phases, which may be produced by any one or more of 13 different ways; he mentions these, most of which are already well known; some of them, however, seem entirely impracticable, especially those which seem to be suggested by himself. Experiments made with these motors some months ago, he states, have given completely satisfactory results.

Transformers—See paragraph above.

Frequencies.—See paragraph above.

Composite Excitation of Dynamos.—In a note before the French Academy of Sciences, reprinted in "L'Ind. Elec.," April 25, and in the "L'Elec.," April 29, Mr. Hoho shows mathematically that it is possible by means of a composite winding of the field magnets to obtain an excitation which will generate a constant E. M. F. in the armature, for variable speeds, or an E. M. F. which will vary according to any desired law with the speed, under the condition that the field is not oversaturated. He shows that by means of a double winding an approximately constant E. M. F. can be obtained which is independent of the influence of variations in the speed, that is, independent of irregularities in the speed of the engine; the double excitation may be produced by two separte and distinct excitors, or one by the machine itself and the other by a small dynamo. Experiments have shown the correctness of this and he is about applying it to the construction of dynamos. The description is not as clear as would be desired.

Dynamo Graphics.—An article on this subject in the Lond. "Elec. Rev." will be found reprinted in full in another column of this issue.

Dynamos and Motors.—See also paragraph on "Electricity and Electrical Appliances" under Central Stations.

Patin Transformers.—"L'Elec.," April 29, describes and illustrates a new transformer of Patin, giving full data of one for 4 kilowatts.

ARC AND INCANDESCENT LIGHTS.

Diffusing Globes.—In "L'Elec.," April 29, Mr. Fredureau describes briefly a new globe for arc and incandescent lights consisting essentially of a number of refracting and total reflecting rings, the object of which is to spread or diffuse the light without entailing such a great loss by absorption as in the usual ground or opal globes.

Arc Lights in Parallel.—"L'Elec.," April 29, describes and illustrates an apparatus by means of which the energy generally lost in dead resistance placed in series with arc lamps may be used to run incandescent lamps.

RAILWAYS.

Electric Railways.—See also paragraph on "Electricity and Electrical Appliances" under Central Stations.

INSTALLATIONS, CENTRAL STATIONS, ETC.

Electricity and Electrical Appliances.—The Lond. "Elec. Eng.," May 5, reprints an article under this heading by Prof. Ayrton forming the introductory monograph to the Electrical Section of the British Catalogue at the Chicago Exhibition. It forms a brief and very interesting summary of statistical information concerning the principal electrical industries in England, and is probably one of the best short summaries published. In the adoption of electricity for industrial purposes which require the use of large currents Great Britain, he says, has been very backward. By the end of 1893 five million pounds sterling will have been spent for providing for the supply of electric current from public mains in that country, exclusive of house wiring; although most of these stations have been carried out by public companies popular opinion now tends toward municipal plants; of 25 new stations undertaken last year 17 were municipal. He gives two short tables, one for London and one for the provinces, giving for the end of 1892 and for each of seven different systems the number of stations the number of lamps, plant capacity, maximum distances and the voltage at station; for London the plant capacity is greatest for the three-wire system with batteries, next greatest for alternating currents with transformers in the houses and least for the two-wire system with batteries and for continuous current arc lamps; at the end of that year there were about 526,000 8-c. p. lamps connected with public mains, of which 330,000 were added during the last two years; these are supplied from 19 central stations having a total capacity of 40,000 h. p.; seven different systems are used; 297,000 lamps are run with continuous current and 229,000 with alternating current; in the provinces there are about 240,000 lamps divided about equally between direct and alternating currents; for the whole of Great Britain there are over three-quarters of a million 8-c. p. lamps or their equiva-

lent run from central stations. In the residential districts of London the maximum number of lamps turned on at one time is about 30 per cent. of those connected with the mains; in stores, clubs or theatres it is 55 to 60 per cent., and in the city (business portion) it reaches 70 per cent., the average for the whole metropolis being about 40 per cent. In private houses each lamp averages one hour in 24, in flats and stores 1½ hours and in clubs 4 hours. The price charged per kilowatt hour varies from eight cents in Newcastle to twenty cents in Eastbourne; in London it varies from ten to sixteen cents. Taking the average light as 8 candles, one kilowatt hour produces about 200 candle hours. In one station the actual cost per kilowatt hour was 1 4-5d. for coal, water, oil, stores, wages and salaries; or including everything 4¼d. A characteristic in British stations is the direct coupling to high-speed engines; the engine mostly used is guaranteed to produce one brake horse power with 19 to 20 pounds of steam; 84 per cent. of the power developed by the steam is given electrically to the street mains in the case of large direct-coupled engines working at full load. The Parsons steam turbine can now generate one kilowatt hour with 28.2 pounds of steam; the lowest charge of any central station is that at Newcastle, where these steam turbines are used (coal and gas are also cheapest in that city). Steam turbine alternators for 21,428 lamps of 8 c. p. are now in course of construction, for which the steam consumption will not be more than about 22 pounds. He states that more attention has been given in that country than in any other to the design of dynamos and motors; motors are now so well made that the average run of a locomotive on the City & South London line is about 10,000 miles before its motors require any repairs; one set of brushes on these motors have served for a 47,000-mile run of the locomotive. The type of dynamo generally employed in England is that of a single horseshoe magnet, and a plain drum armature below. Electric motors are not used much in connection with factories, but their usefulness is beginning to be appreciated. The aggregate horse power of all dynamos and motors constructed in that country during the past three years is about 100,000. One firm has orders on hand for alternators to supply current for 900,000 lamps of 8 c. p. A new London station will contain 16 alternators of 500 kilowatts. Self-excitation of alternators is almost unknown in that country; their practice is to connect all field magnets of alternators in parallel and excite them from separate dynamos driven by separate engines. The use of accumulators in central stations, he thinks, is probably coming to an end. An average efficiency of 83.5 per cent. was obtained last year with accumulators in daily use in London stations. For private country installations they are much used, also for the propulsion of boats; there are now about a hundred electric launches on the Thames; 2,200 cells were turned out last year by one firm for launches and general purposes and 14,000 for lighting purposes. For traction purposes non-pasted plates are now being tried, and at a charge of three cents per car-mile for maintenance the makers are reaping a profit. The total cost per kilowatt in private house installations of about 50 lamps of 16 c. p. is about 12 cents per kilowatt hour when run with gas engines; gas engines developing 170 h. p. worked with Dowson gas require only four-fifths of a pound of anthracite coal per indicated horse power per hour. An exact experiment has been carried out in the London waxworks exhibition showing the relative costs of lighting by electricity and gas to be about as 12 to 13.7 in favor of electricity. About 100 Priestman oil engines are used in electric light installations, in which the consumption of oil per brake horse power is said to be about one pound. Electric traction has made but little headway in Great Britain. He gives some data about the City & South London underground railway; the cost per train-mile on this road, including everything, has been reduced to 14.2 cents. Submarine telegraphy is today carried on by means of 139,594 nautical miles of cable, for the repairs of which 37 ships are used; nearly all these cables were made in England. Over 70,000,000 paid messages were transmitted last year by the British land lines and about 3,400,000 words are daily sent by the Exchange Telegraph Company to clubs, newspaper offices, etc., where they are received in Roman characters at the rate of 40 to 45 words per minute.

Practical Electrical Problems at Chicago.—The Lond. "Elec. Eng.," May 5, reprints a Society of Arts paper on this subject by Prof. S. P. Thompson. He does not discuss the topics which are to be submitted to the congress; he compares English practice with American practice more particularly in regard to electric lighting plants, and asks whether among the many points of divergence there is not a best way to be chosen; he dwells at some length on the use of belts in America (of which he does not approve) and their absence in England; also on switchboards and the methods of connecting dynamos. It forms interesting reading as a comparison, but contains nothing new.

Gas Engines—Mr. McMullen, in the Lond. "Electrician," May 5, calls attention to the fact that the usual gas engines are manifestly unsuitable for running alternators in parallel. He claims that such engines should have at least two impulses per revolution. He says manufacturers should work in the direction of quadrupling the number of impulses if such engines are ever to be used for alternating current stations. Governing down to at least half load must be performed by varying the power of the explosions and not by cutting them out all together.

Small Gas Engine.—The Lond. "Elec. Rev.," May 5, describes a new gas engine for small powers.

Municipal Station in Berne.—"L'Ind. Elec.," April 25, gives a short description of this station.

WIRES, WIRING AND CONDUITS.

Fault Indicator.—An instrument for automatically indicating the location of a fault on underground conductors has been in use on a very large network in Berlin for over a year, and it appears to have met with success. These indicators sound an alarm at the station the moment a fault is developed and indicate the locality. For this purpose the usual pressure wires are used which are so connected that a certain voltage exists between the copper conductor and the neighboring pressure wire; when a cable is damaged the short circuit which then occurs between the pressure wire and the copper conductor produces a change in the voltage existing between them, which in turn actuates a relay and an alarm at the station without necessarily preventing the pressure wire from serving its purpose for indicating the pressure; the relay actuates an annunciator which indicates the district, each district comprising about a square. Besides this there are ground detectors at the station which show the condition of the insulation not only of the whole network, but of every single district. The system is based on the fact that the largest part of the loss of potential between the two points connected to earth is at those points, only a small portion being due to the resistance of the earth between the points; the conductors are therefore made to indicate the potential of the earth in the various districts; by means of single relays and simple voltmeter measurements, the locality of the fault is determined at the station. The sensitiveness can be made as great as is desired: the relays, for instance, can be made to operate with one-quarter of a volt or one volt, depending upon whether poor or good ground connections are to be indicated. A somewhat lengthy description of this system may be found in a paper by Dr. Kallmann, in the "Elek. Zeitschrift," No. 11. The system is one devised by the Allgemeine Elektricitaets-Gesellschaft.

A lengthy discussion of this paper is contained in the "Elek. Zeitschrift," April 28, the greater part of which, however, is devoted to the influence of earthed lighting circuits on telephone lines. The author explains a portion of his system by the aid of a diagram representing an actual case. His system seems to be of considerable importance, and is well worth the attention of central station engineers. Some of the remarks of Dr. Froelich are of interest; he compares it with his own (complicated) system (mentioned in these columns some weeks ago) and states that the former is not applicable if the faults are in the house circuits, where most of them occur; this, however, Dr. Kallmann denies, saying that he has applied it in numerous such cases; both agree that grounding the neutral wire of a three-wire system diminishes materially the disturbing influence on neighboring telegraph and telephone lines.

Most Economical Cross-Section.—Mr. Vogel, in the "Mittheilunger d. Ber. Elek. Ver.," No. 3, discusses Lord Kelvin's well known law concerning the most economical cross-section of a conductor, and deduces in like manner a similar law which takes into account the cost of the insulation. He gives mathematical formulas by means of which the most economical cross-section can be calculated, knowing the thickness and cost of the insulation. The formulas are too complicated to be given here.

TELEGRAPHY AND TELEPHONY.

Telephonic Meter.—The Lond. "Electrician," May 5, describes and illustrates a meter the object of which is to check the misuse of a telephone by non-subscribers and also to enable charges to be made in some degree commensurate with the number and length of conversations; the present meter was designed to meet the demands of the German government. It consists essentially of a clock the pendulum of which is caught and thereby stopped by a lever connected to the hook lever for the telephone, the clock stopping as long as the telephone is hanging on its hook. When the clock needs winding it automatically locks the telephone switch and operates a little signal disc; before the telephone can be switched onto the line the clock must be rewound. (There seems to be nothing to prevent the subscriber stopping the clock; an escapement movement might overcome this objection, in place of a pendulum movement.)

Telegraphy.—See also paragraph on "Electricity and Electrical Appliances" under "Central Stations."

ELECTRO-CHEMISTRY.

Application of Electricity to Chemistry.—The third and last lecture of Mr. Swinburne is given in the Lond. "Electrician" and the Lond. "Elec. Rev.," May 5, the former containing a cut of an incandescent furnace. The lecture is devoted to the subject of the electrolysis of gas. He considers that gases are electrolyzed by the electric discharge; ozone is made by breaking down air by means of the electric discharge; the ozonizer consists essentially of two glass plates, the disruptive discharge taking place between them, the electrodes being on the outer surfaces, thus avoiding the contact of the ozone with the metals; the simplest form consists of two tubes, the air or oxygen passing through the annular space between them, the electrodes being on the other sides of the glass. The electromotive force necessary to produce electrolysis is of vital importance in commercial work, and it is not necessarily proportional to the heat of combination of the radicals set free. In speaking of electrical furnaces he says that Mr. Moissan's experiments are quite old excepting only the production of black diamonds. The Cowles furnace is now used largely for the production of phosphorus from calcium phosphate. He describes a furnace devised by himself in which the materials are not acted upon by the arc direct (illustrated in "Electrician"); the material is placed in a carbon crucible which is itself placed between the two electrodes, thus forming two arcs, or if the carbons are in contact an incandescent furnace is obtained; the advantages are that it is easy to control, that the charge is not mixed with lime and cannot run away; in one form the crucible is at the centre of two copper hemispheres tinned and polished inside with a pinhole for projection, enabling the crucible to be watched.

Electrolytic Chlorine and Soda.—In the Lond. "Elec. Rev.," May 5, Mr. Andreoli continues his criticism of Dr. Hopkinson's report on the Richardson-Holland process. That report says that for every electrical horse power there is a production of 1.07 tons of Na_2O and 1.2 tons of chlorine gas; also that it takes 6 volts per tank. Mr. Andreoli discusses this at considerable length, claiming that 6 volts represents a great loss of power, as 4½ volts is all that is required in other processes; also that it would be better to state what the actual yield is instead of the theoretically calculated yield, and what percentage the one is of the other. He gives a large number of practical questions which he thinks ought to be answered in such a report. He also discusses the report of Mr. Liveing, in which it is said that the difficulty of the mixing of the chlorine and soda is practically overcome by the use of non-porous partitions.

Electric Tanning.—Mr. Groth, in the Lond. "Elec. Rev." and "Elec. Eng.," May 5, refers to the recent paper of Mr. Falkenstein (see Digest, April 29), criticising it unfavorably on the grounds that the experiments were mere laboratory experiments, under conditions which never exist in practice. Mr. Falkenstein is the electrician for the company working the Worms and Bale process which Mr. Groth (apparently the patentee of the Groth system) claims has never been a commercial success. He thinks that Mr. Falkenstein ought to have given the commercial results of the Worms-Bale system instead of those of laboratory experiments. He states that some of the figures are incorrect, and that according to Rideal and Trotter the average values for the rate of tannage are as .133 for ordinary tannage, .503 with motion, and 2.08 with motion and electricity, which latter Mr. Groth claims is his patent; the latter figure shows that the rate is 16 times faster in the Groth system than in the ordinary system. He claims that Dr. Rideal's remark in "Industries," "that tannins which yield much bloom should be avoided in electrical work," is not in accordance with facts, as he is daily using sumac without the slightest difficulty; he adds that the electric current must be regulated according to the nature of the hides and the composition of the liquor.

Etching.—An interesting letter, written by Thomas Spencer, the supposed discoverer of the electrotyping process, in 1841, is published in the London "Electrical Review," April 28. In this he describes his invention, in 1840, of etching by means of electricity, as the reverse of electroplating; he describes the difference in etching by this method and by means of acid, and mentions the results which he has obtained; when very fine lines are to be produced he uses a neutral solution of a salt which contains an acid having but a small affinity for the metal. By varying the angle of the opposing plate any depth of tint may be acquired; daguerreotypes may be engraved very successfully.

Disassociation.—The London "Electrical Review," April 28, calls attention to a paper by Shields in the "Philosophical Magazine," Vol. 35, No. 215, p. 365, on 'Hydrolysis in Aqueous Salt Solutions," the chief object of which is the determination of the free alkali in aqueous solutions of salts, such as potassium cyanide.

Electrolysis of Aluminium.—Mr. Haubtmann continues his serial on this subject in "L'Elec.," May 6. The present section treats of the fundamental laws of electrolysis; he also gives a short description of the Cowles process.

Accumulators.—See also paragraph on "Electricity and Electrical Appliances" under Central Stations.

MISCELLANEOUS.

A New Insulating Material.—The All. Elek. Gesellschaft, of Berlin, one of the largest electrical companies in Germany, has introduced a new insulating material called "Stabilit." It is to replace hard rubber and the numerous vulcanized fibre materials. It can be turned, filed and drilled easier than the hard rubber, admits of cutting fine screw threads and can be polished; it does not attack metals and can be used in place of marble and slate for switchboards; it is not hygroscopic; it was uninjured by boiling twelve hours in water, which

neither hard rubber nor fibre would stand; it resisted a temperature of 250 degrees C.; it is not attacked by hydrochloric or dilute sulphuric acid, nor by alkalies, and is suitable for accumulator cells; after being in moist air for four weeks its insulation in megohms per cb. cm. was reduced from 10,000 to 8,500, while that of vulcanized fibre was reduced from 8,000 to 6,000; a sheet .028-inch in thickness was not pierced with 5,000 volts.

Electric Launches.—See also paragraph on "Electricity and Electrical Appliances" under Central Stations.

Training of Electrical Engineers.—The Lond. "Elec. Eng.," May 5, continues its serial on this subject.

Differential Meter Clock.

Central station managers appreciate the importance of a high load factor from an economical point of view, and will be interested in the following description of an apparatus which has been designed by Mr. Gisbert Kapp, of Westminster, Eng., with the object of encouraging the use of current at a reduced charge per supply unit during those hours of the day or night when the call for light is a minimum. The apparatus has been tested on the circuit of the supply station operated by the municipality of St. Pancras, London, and has been found to answer perfectly.

Before describing the particular form of Kapp's differential meter clock, which we illustrate herewith, it will be well to say a few words on the general principle of differential meter rates and previous attempts to carry this principle into practice. It will be readily seen that were it possible to insure a full output from a supply station all day long, the rate at which the unit of electric supply can be produced would be materially reduced. This is partly due to the higher efficiency with which the machinery works at full load and partly to the decrease in that part of the working expenses which is represented by interest, depreciation and sinking fund on plant and by supervision. In order to even approach such an output it is of course necessary to sell current at such a low rate that consumers will find it advantageous to use the current for motive power, heating and other purposes, but it is not advantageous to sell current at low rates for lighting purposes. The use of current for lighting requires no encouragement, and it would, therefore, be bad policy to lower its price. It would also be bad policy to sell current for motive power at low rates during those hours that the bulk of the business is done in lighting, because that would necessitate the erection of more generating plant. What is really required is to encourage the use of current, whether for heating, working, lighting, power or any purpose, during those hours of the day and night when no appreciable demand exists for lighting, and this may best be done by lowering the rate at which the current is sold during those hours, reverting, of course, to the full rate during regular lighting hours.

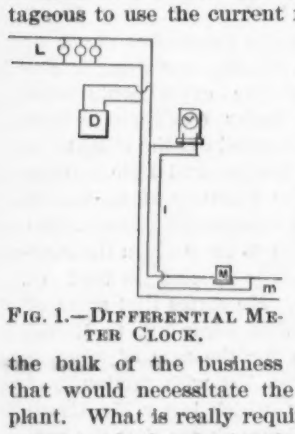


Fig. 1.—Differential Meter Clock.

One method of securing these advantages, which has been adopted by the City of London Electric Supply Company, is to provide the customers with two meters (one registering the supply at the normal and the other at the reduced rate), with a suitable two-way switch, by which either of the two meters, but not both at the same time, can be thrown into circuit. The switch is kept under lock and key, and a switchman in the employ of the company goes round twice daily to work the switch by hand. Where only a few customers are requiring the differential rate this hand switching may be tolerated, but it would be quite inadmissible where a large number of customers wish to avail themselves of the differential rate.

Another method, originally used in St. Pancras, is to use not only two meters, but also two distinct circuits,

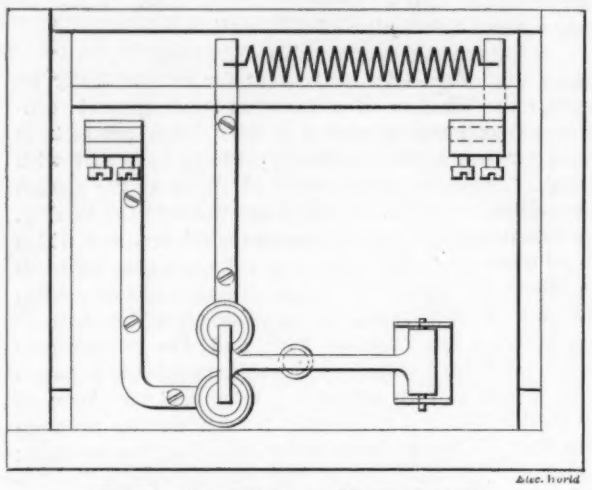
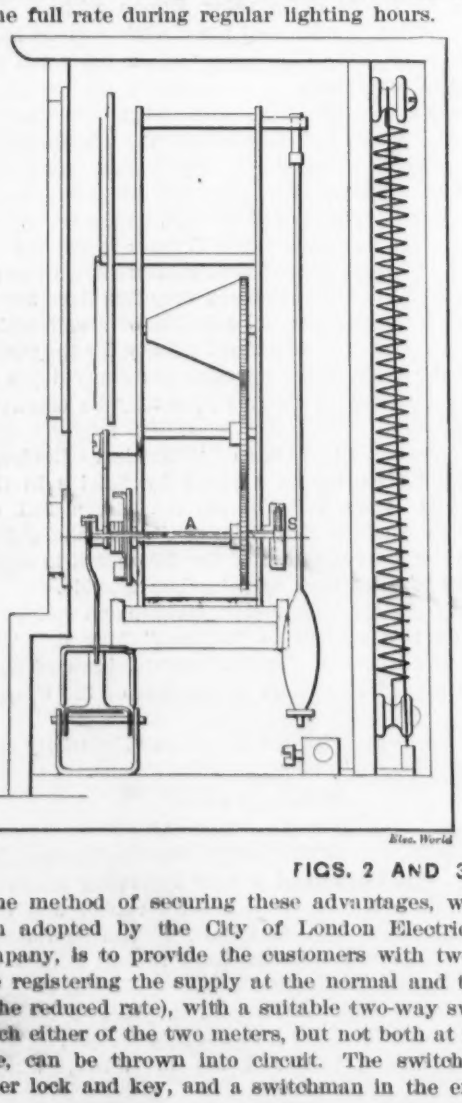
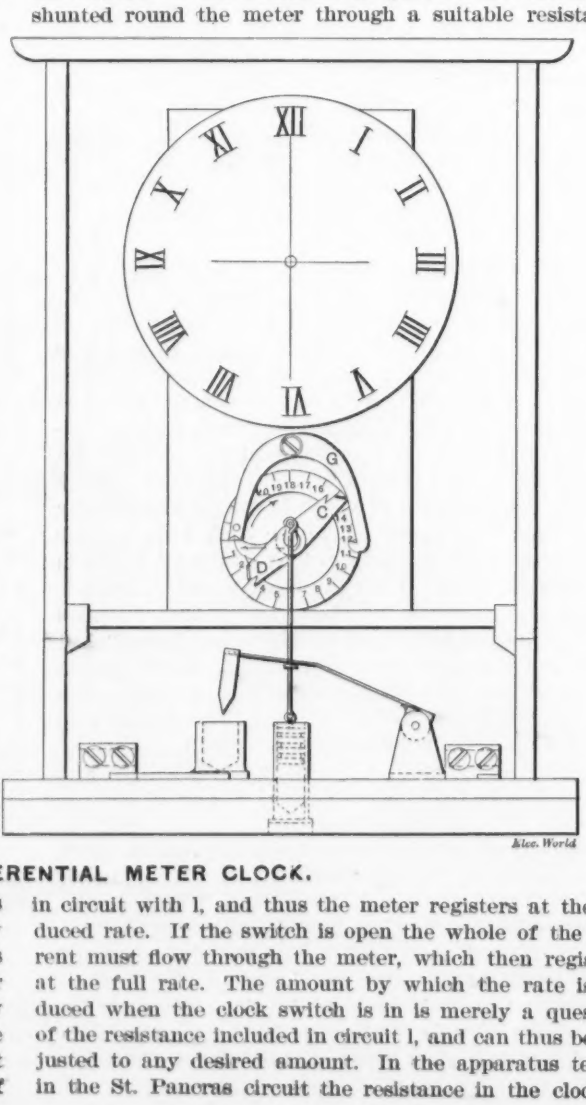


Fig. 4.—Differential Meter Clock.

one for the general lighting of the premises and the other for the motor. A special switch is employed by which the full rate supply can be sent simultaneously through the lighting and motor circuit, but the supply at the reduced rate can only be sent through the motor circuit. The customer works the switch himself, the presumption being that as he requires the light in the evening he is forced to put himself on the full rate. By dispensing with the light he may, however, put himself on the low rate at the very time when the load on the station is heavy, and this, although advantageons to the customer, is very undesirable from the point of view of the central station manager.

The device which we illustrate herewith has been designed with a view to overcome, on the one hand, the objection of letting the consumer himself control the rate at which he is supplied, and, on the other, the equally serious objection of having to send a man round from house to house to effect this control. In Kapp's apparatus the change over from the full to the reduced rate, and vice versa, is effected automatically by means of a clock, and only one meter is used. The clock may be placed in any convenient position on the premises of the consumer, the connections being arranged as shown in Fig. 1, where m represents the mains coming in from the street, M represents the meter, which may be of any type, C the controlling clock, L the lamps, and D a motor or other apparatus. One additional lead, l, is required for joining the meter with the clock, the rest of the wiring and connections to motors, lamps or other translating devices being left undisturbed. The office of the clock is to throw at predetermined hours a switch in and out, whereby the load, l, is thrown into or taken out of the circuit. If the switch is in, part of the current is shunted round the meter through a suitable resistance





FIGS. 2 AND 3.—DIFFERENTIAL METER CLOCK.

in circuit with l, and thus the meter registers at the reduced rate. If the switch is open the whole of the current must flow through the meter, which then registers at the full rate. The amount by which the rate is reduced when the clock switch is in is merely a question of the resistance included in circuit l, and can thus be adjusted to any desired amount. In the apparatus tested in the St. Pancras circuit the resistance in the clock is equal to that of the meter whereby the rate is halved, so that the charge of 6d. per Board of Trade unit is lowered to 3d. during the daytime.

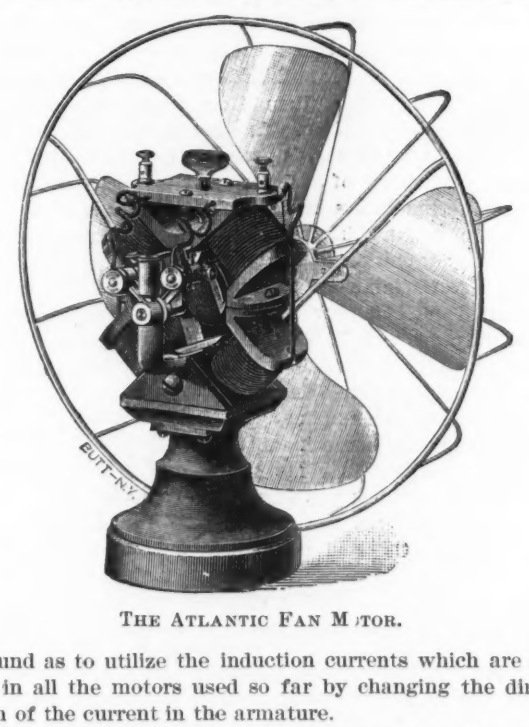
Figs. 2 and 3 show the internal arrangement of the apparatus. It consists of an ordinary eight-day clock, with the addition of a wheel and hollow shaft, A, so geared as to revolve once in 24 hours. Inside A is a solid shaft provided with a crank and cam, F, at one end, and connected to a spiral spring, S, at the other end. On the hollow shaft is keyed a disc, and in front of the disc, held to it friction-tight, are two pallet arms, D and C, which can be set into any position relatively to the hour marks engraved on the front plate of the clock frame. The cam, and with it the solid shaft, is prevented from rotating by the fork G. The latter is provided at the back with a pin placed in such position as to be pushed to one side or the other when the pallets pass it. Thus the cam is released and allowed to fly round half a revolution, whereby the crank is alternately brought to its highest or lowest position, thus opening or closing the switch. To prevent too sudden a movement of the switch the latter is provided with a dash-pot. The resistance is inclosed in the back of the case of the clock, seen in plan in Fig. 4, and can easily be adjusted to suit any meter and any desired ratio between the full and the reduced rate of supply.

Fig. 4 gives an outside view of the clock. The whole of the gear is of course under lock and key and only accessible to the inspector of the electric supply company; but as it is convenient for the consumer to know at any time the rate at which he is then being supplied, a window is placed opposite the cam in the front corner of the clock case, and by observing the position of the cam the rate is seen at a glance.

The clock has to be wound once in eight days, but arrangements are now being made to adapt the controlling mechanism to self-winding clocks.

The Atlantic Fan Motor.

In the accompanying illustration we present the latest type of the Atlantic fan motor. This is a new motor with an entirely novel armature, so constructed and



The Atlantic Fan Motor.

wound as to utilize the induction currents which are set up in all the motors used so far by changing the direction of the current in the armature.

The high efficiency which, in consequence of the novel construction, is claimed for this motor is a special feature which will attract the attention of the trade and no doubt secure for the Atlantic motor a front place among the motors in use.

It is understood that the Electro-Chemical and Specialty Company, 136 Liberty street, New York, has made arrangements to place the Atlantic fan motor upon the market, and is prepared for a large trade for the coming season.

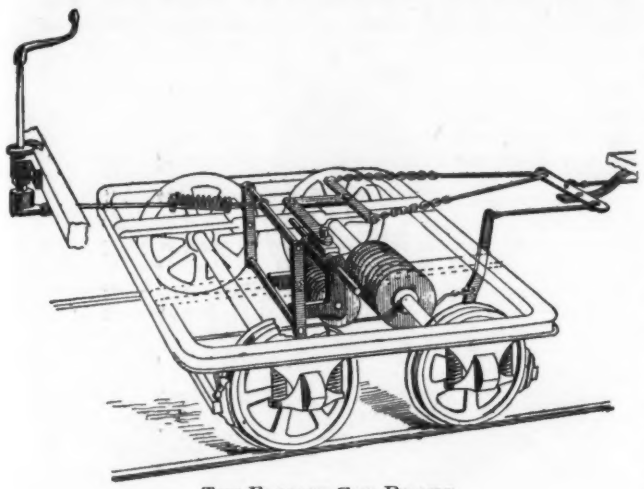
The Elliott Car Brake.

Although there have been innumerable car brakes for street cars invented, the form generally in use to-day is one of the oldest. While some of the newer forms are in many respects better than the one at present generally used, they are often too complicated, too expensive or are liable to get out of order, and this has been particularly true of those by means of which it has been attempted to utilize the inertia of the car as the braking force. A brake recently invented by Mr. G. R. Elliott, of Boston, however, seems to possess the requirements of simplicity and certainty of action, and at the same time introduces in a novel way the principle of braking through the car's inertia.

A chilled iron cylinder having a screw thread cut upon its surface is firmly fixed upon the axle of one pair of wheels of the truck of a car; a like cylinder, of smaller dimensions, is hung in bearings at the lower end of a lever frame in such a manner as to bring it parallel to that upon the axle. The fulcrum of this lever frame is

an iron rod having loose bearings in the woodwork of the truck frame, and with this rod the lever frame carrying the smaller screw cylinder reciprocates.

To the upper end of the lever frame is attached the rod leading to the brake handle, which rod is divided and has a spiral spring interposed at the junction in such a manner as to make the pull of the brake elastic. A half turn of the brake handle draws this rod forward, causing the lower part of the lever frame, which bears the small screw cylinder, to move toward the larger screw cylinder fixed upon the axle of the wheels with which it engages and by which it and the lever frame carrying it are moved toward one side or the other of the car, according to the direction in which the latter is moving. A

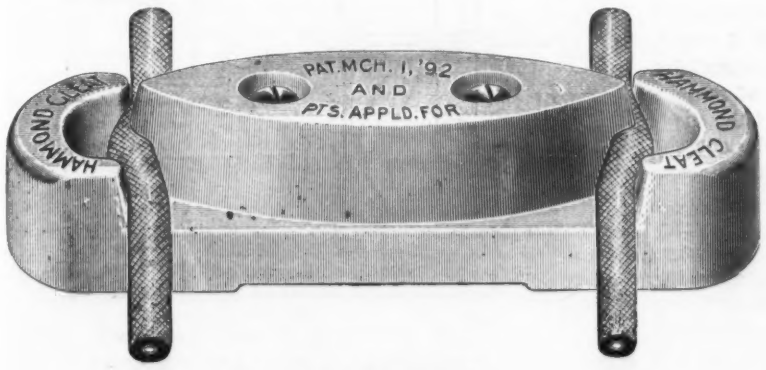


THE ELLIOTT CAR BRAKE.

link-arm, one end of which is attached to the lever frame and which, moving with it, is connected by its other end to the end of one arm of a three-armed rocking lever fulcrumed at the junction of its three arms and operating in such a manner that whichever direction the lever frame takes, by reason of its small screw cylinder engaging with the screw cylinder on the axle, the three-armed rocking lever will be moved so as to cause one of two links connecting two of its arms to an ordinary straight lever at one end of the truck frame to draw inward, thus causing the other end of the last mentioned lever to move outward, carrying with it the rod connecting it with the beams of the brakeshoes, and thus bringing the brakeshoes against the tread of the wheels against the stress of springs which withdraw the shoes the instant the brake handle is released.

A very slight turn of the brake handle will bring the screw cylinders into engagement, and the smaller cylinder will immediately begin to move in a direction at right angles to the length of the car and parallel to the axis of the axle upon which the fixed screw cylinder is located, and it will continue to move in this direction until the strain upon the brakes exceeds the pressure exerted upon the brake handle, when it will disengage and fly back toward its former position, engaging again instantly the excessive pressure ceases, and repeating this action until the car stops. This is accomplished so rapidly that the effect upon the car is the same as would result from a continuous pressure of the brakeshoes against the wheels, yet the several pressures have the effect of destroying the sudden jerk resulting from the locking of the wheels, and, while avoiding the friction and consequent flattening of the peripheries of the latter, is none the less effectual in bringing the car to a stop.

In one end of the rod forming the fulcrum of the lever frame carrying the small screw cylinder is fixed a pin which reciprocates with the rod and causes an angular three-armed rocking lever in the crotch of which it plays



THE HAMMOND CLEAT.

to throw to one side or the other, according to the direction of its movement, and that of the rod from which it projects.

The angular rocking lever is attached by one of its arms and a link to a similar lever of a "T" shape, the latter in turn operating an arm arranged above a rheostat. The rheostat also has an arm against one side of which the last mentioned arm is pressed when going in the direction to cut off the current when the brakes are put on; but when the brakes are released the rheostat arm is left turned so that the motorman must by the ordinary means within his control turn on the current to start.

It will thus be seen that, while putting on the brakes turns off the current, throwing off the brakes does not turn on the current, but leaves the car at a standstill until the motorman chooses to start it, when the brakes are in position not to retard its progress.

It is obvious that, with the parts for governing the electric current left off, this brake is as well adapted for horse cars as for those operated by electricity.

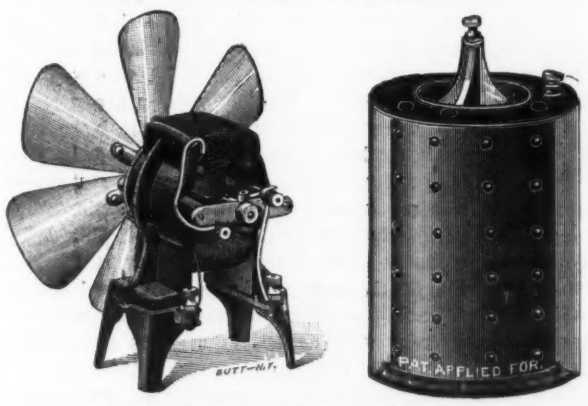
The Hammond Cleat.

In the accompanying illustration is shown the Hammond cleat, manufactured by the Hammond Cleat and Insulator Company, 15 Custom House street, Boston, Mass. This cleat is made in one piece of the finest grade of glazed porcelain, and is claimed to furnish the quickest and easiest method of wiring. It does away with the unsightly tie wire, and can be made with one, two or three openings, adapted to receive all ordinary sizes of wire. It holds the wire firmly, with no danger of breaking the insulation.

The De Mott Fan Motor and Battery.

The fan motor is constantly enlarging its field and every year it continues to become more popular. Although there are a great variety of fan motors on the market, yet each new one that makes its appearance seems to have some points of superiority which entitle it to a claim upon the field. One of the recent machines of this type is that shown in the accompanying illustration, which is manufactured by the De Mott Motor and Battery Company, 173 Greenwich street, New York City. This motor is extremely simple and effective, and has been placed on the market only after the most thorough test. It is especially designed for a low amperage, but at the same time runs at a high rate of speed. Its electrical and mechanical features are carefully worked out and attention is also given to the symmetry of the motor. It is claimed to be noiseless while in operation and free from any danger of getting out of order.

The De Mott battery is shown in Fig. 2, and is made in two sizes: Type A, 5×7 inches, is intended for mechanical toys, models, etc., while type B, 6×8 inches, is for fan motors and telegraph and signal work.



THE DE MOTT FAN MOTOR AND BATTERY.

The company recently received a letter giving the results of a careful test of one of these batteries lately set up, which showed it was capable of delivering a practically constant current on short circuit of 2.39 amperes at an E. M. F. of 1.079 volts, the internal resistance being less than one-half of an ohm.

This company also manufactures the De Mott "turret" fan motor. In this machine a revolving turret placed above the motor carries a spindle upon which the fans are mounted, the fans being kept in motion by friction wheels resting on the turret. By this arrangement the fans revolve rapidly so that they distribute the breeze uniformly in all directions.

The "Multum in Parvo" Electric Yacht Lamp.

A novelty in the shape of an electric fixture especially designed for yacht lighting was shown us recently by a representative of the Storage Battery Supply Company, Twenty-third street and First avenue, New York, which is among the most complete and attractive arrangements for yacht lighting that has been placed upon the market.

This fixture is designed for use on yachts or in any place where economy of space is necessary, to take the place of the regulation bulb and cumbrous attachments. Briefly, it may be described as a polished silver reflector with supporting rim, in front of which is suspended an incandescent lamp of the required candle power. This is covered by a curved plate glass that may be cut or etched in any design. The glass fits tightly over the rim, thus sealing the reflector and lamp from contact with the air. The accompanying illustration gives an idea of the construction of the "Multum in Parvo" lamp.

The advantages claimed for this combination are: 1st. It gives the greatest amount of light for the least ex-

THE "MULTUM IN PARVO" ELECTRIC YACHT LAMP.

penditure of energy. 2d. Being self contained, it requires the very smallest amount of space and thus may be placed where it would be impossible to use the old style. 3d. The lamp and reflector are sealed out of contact with the air, and so remain bright and clean indefinitely. 4th. It is beautiful in its simplicity and ornamental when not lighted.

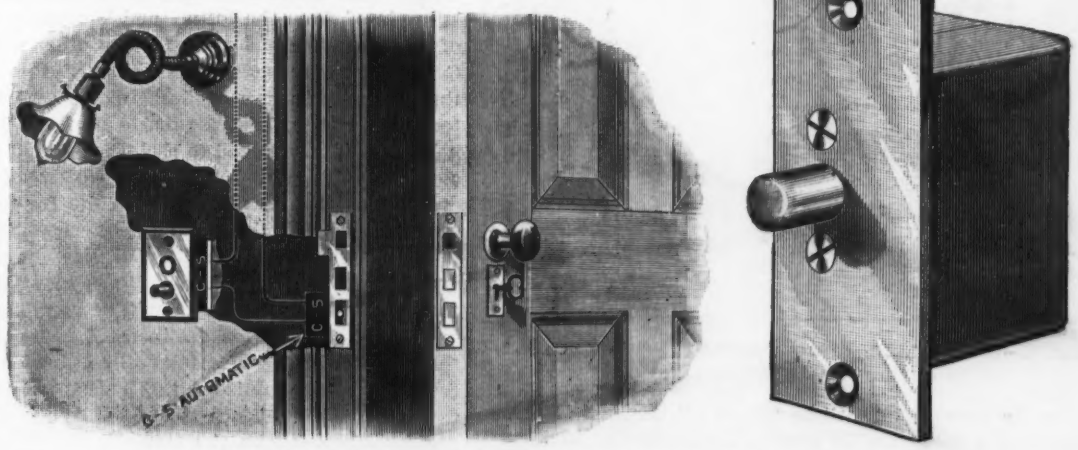
These lamps are made in three standard sizes: No. 1 is four inches in diameter and ¾-inch high. This is suitable for berths, closets, and small state rooms. The lamp may be of from one to four candle power. When placed over a berth it forms a most desirable light for reading. No. 2 is six inches in diameter and two inches high. An eight or sixteen candle power lamp may be used. No. 3 is eight inches in diameter and two inches high. The same lamps may be used in this size as in No. 2.

A Novel Application of the C-S Automatic Switch.

In the accompanying cuts Fig. 1 illustrates the C-S Automatic Switch, the action of which was fully described in The Electrical World of May 6, 1893, while Fig. 2 shows a novel application of this switch, wherein it is so arranged as to arbitrarily cut out the current from a hotel guest chamber by process of locking the door from the outside.

It is probable that no other hotel expense is so greatly augmented by the negligence of guests as is that attendant upon lighting the rooms, and this is particularly the case where the electric light is used. Indeed it is estimated that 90 per cent. of all hotel guests invariably leave their lights burning upon vacating their rooms.

In the modern hotel it is the practice to fit the doors of all guest chambers with "secret" or double-bolt locks,



A NOVEL APPLICATION OF THE C-S AUTOMATIC SWITCH.

one bolt being operated from the inside, the other from the outside, and it is by taking advantage of this arrangement that the C-S switch is made to perform this service of economy in a most successful manner.

As is shown in Fig. 2 a "C-S Automatic" is placed in the molding of the door jamb immediately back of the striker plate in such a manner that the "push" of the switch is directly in line with the movement of the bolt that is operated from the outside of the door. With this arrangement it will be understood that, when in the process of locking the door from the outside the bolt is thrown, it engages with the switch push, thus "opening" the switch and turning off the lights, while locking the

door from the inside has no effect whatever upon the action of the switch.

However, to provide means whereby the occupant of the room may turn the light off from the inside where desired, an auxiliary switch is placed on the inside of the room, in circuit between the controlling doorlock switch and the lamps, in such manner that while the door remains unlocked upon the outside the lamps may be turned on or off at will in the usual manner; but, whatever the position of this auxiliary switch may be, as to whether the current is off or on, when the occupant locks his door from the outside upon leaving the room the lights are invariably turned off.

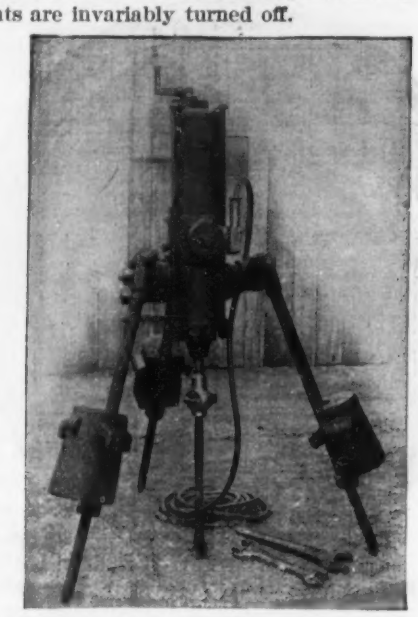


Fig. 1.—General Electric Company's Electric Percussion Drill.

This unique and valuable device is a recent addition to the well known line of C-S specialties manufactured by the Cutter Electrical and Manufacturing Company, of Philadelphia, and, although comparatively new, they have already been placed in all the rooms of the Great Northern Hotel, Chicago, and other well known hotels are now being fitted with them.

General Electric Company's Electric Percussion Drill.

The electric percussion drill since it was first put into practical operation has undergone many changes, each tending toward perfection, until to-day it can compete successfully either with the steam or compressed air drill.

An interesting percussion drill plant is that in operation at the limestone quarries of the Solvay Process Company, near Syracuse, N. Y., which has been working continuously for several months and with excellent results. Installed by the General Electric Company at the commencement of the past winter, the drills have operated without any interruption from the intense cold, and have practically demonstrated the advantages derivable from the use of electricity in quarry work. Had steam been the only available power, the loss in transmission by condensation at 20 degrees below zero would have been, it is claimed, so great that the drills could not have been worked. The quarry, as will be seen from the accompanying cut, is situated in a desolate spot on an elevated plateau, where the intense cold found full scope for action.

Fig. 2.—General Electric Company's Electric Percussion Drill in Operation.

At the present time three "Type E" General Electric Company's drills are in continuous operation 10 hours per day, drilling holes from 6 to 10 feet in depth, and 2 to 2½ inches in diameter at the top. The rate of drilling, according to the record kept by the superintendent, is from 45 to 75 feet per 10 hours, averaging 50 feet per day, or 1,500 feet per month of 30 days. The average distance of the drills from the power station is about 2,000 feet at the present time, the circuit, three lines of bare No. 0 copper wire, being extended to a distance of 3,000 to 3,500 feet from the power station in one direction.

The general dimensions of the "Type E" drills, three of which are doing all the deep hole drilling for the quarry, are: Length over all, 49 inches; outside diameter, wrought iron tube, 7½ inches; length of stroke, 5 to 7 inches; blows per minute, 380.

The generator which supplies the power is of the bipolar type, running at normal speed, and is provided with a device for directing the current alternately into the upper and lower coils of the drills. The difference of potential at the fixed brushes of the generator is 240 to 250 volts. The generator is belted to a 9×12 inch Straight Line engine, supplied with steam at 90 pounds pressure from a horizontal tubular boiler, fuel for which is brought for three miles over the cable way in the buckets used to transport the lime rock from the quarry to the works. As yet no estimate of cost of repairs can be given, because up to date there have not been any. Should, however, any part break down, it can instantly be replaced, as all the parts are interchangeable.

The Pentz-Reckenzaun Electric Meter.

About the year 1881, Profs. Ayrton and Perry constructed a meter and published results based upon the difference in registration of two clocks, one of which was fitted with a magnet in lieu of the ordinary leaden or brass bob weight, the arc of the swing taking place over a solenoid coil, through which circulated the current to be measured. Shortly after this Dr. Aron brought out the meter which is associated with his name, and is so well known. In this form the registration which represented the measured consumption of electricity was given on a dial, the difference in time between the two clocks being taken mechanically by differential gearing, thus simplifying the use of such a meter, and reducing the necessary calculations, which resolved themselves into multiplying the reading by a constant to obtain ampere-hours, or assuming constant pressure on the supply mains, units. Recognizing the difficulty of all clock meters, which Profs. Ayrton and Perry discovered, Messrs. James A. Pentz and Anthony Reckenzaun designed instruments with the view of freeing them of all the weaknesses which were inherent in such clock meters; this involved several years' experimenting and assiduous attention until the instrument here illustrated reached its present commercial efficiency. Some of its main features are that the meter contains no spring, no loose hanging pendulums, no clockwork arrangements, no escapements, and yet it is a perfect timekeeper, owing to the force of gravity being utilized for actuating the oscillating bars.

The new meter requires no attention in the way of winding, being driven by current taken from the supply. The cost of maintenance and driving should be small, and as an extremely low current only is used in the driving magnets—somewhere about 1-60 of an ampere—many of the existing objections raised to the employment of a potential circuit in a meter do not apply to this. The recorded value can be given directly in units.

The mechanism in the meter may be considered under three heads: First, the standard metronome; second, the electrically influenced pendulum and its gear; and third, the recording and indicating apparatus.

The electromagnetic driving apparatus and the pendulum bar of one side of the meter are shown in Fig. 2, while the side view of the pendulum is given in Fig. 3. A general view of the meter, with the cover removed, is shown in Fig. 1, which gives a fair idea of its construction. When a current circulates in the main coil, owing to a demand on the consumer's premises, the magnetic needle of the relay is deflected, closing the driving circuit and starting the pendulums. As the arrangement of both pendulums is electrically similar, it will only be necessary to trace the course of the current in Fig. 1, which represents half of the mechanism, to understand the action of the meter. The bar, K, is insulated from the frame, and is connected to one end of the electromagnet coil, C. The other end of the coil C is taken to the negative side of the lamp circuit, through a resistance of 5,000 ohms, and the potential terminal on the right hand side of the principal terminals, which is connected to the other side of the circuit by a small well insulated wire. The positive side of the circuit is made through the relay to the frame of the magnets, and thereby the contact screw enables the current to flow to the pendulum bar, thence through the coils and the route described. At the moment the current is turned on the armature, D, will be attracted, and consequently the pin, H, on the lever, E, will fall, permitting the full weight of the gravity piece, J, to drop upon the crosspiece, R, which is a lateral extension of K, and thus the latter is started into vibration. When the end of the gravity piece strikes the stop, T, the driving circuit is broken by R, leaving the screw, S; the armature, D, therefore, immediately falls, and in so doing resets the pin, R, to its first position, being limited in its upward movement by the stop screw, W. On the pendulum swinging back the cycle of operations is again repeated, and this continues so long as the relay needle is deflected by current passing through the main coil.

The driving power of the metronomic systems is obtained by the force of gravity, which acts upon a definite mass free to fall a given distance, and is, therefore, independent of the variation in driving current due to fluctuations in the voltage on the mains. The registration is effected by causing the dependent catch bar, L, to actuate the ratchet wheel shown on Fig. 1, so that for every complete swing of the bar, K, a tooth in the wheel is moved forward and the swing registered upon the recording apparatus.

The arbor of one clock being hollow allows the arbor of the other one to be brought through it. The former carries the dials on a frame, the latter a wheel which gears into one on the frame, so that if the two axles revolve together the relative position of a pointer fixed to the wheel carried by the frame, and a point on the dial itself, is unalterd. When, however, one axle is given a higher rate than the other, the difference is indicated by a displacement of the pointer; and by suitable counting gear the registration of consumption is effected.

Such sparking as might occur with the small current broken periodically at S has been practically eliminated by a special compound winding of the magnet coils. The bar, R, and screw, S, are at different radii from centre of

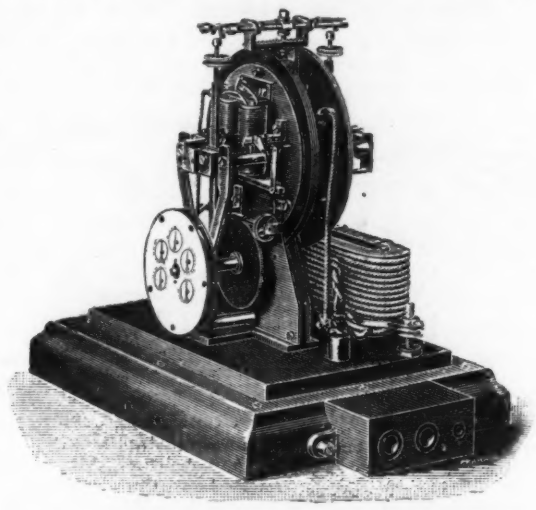
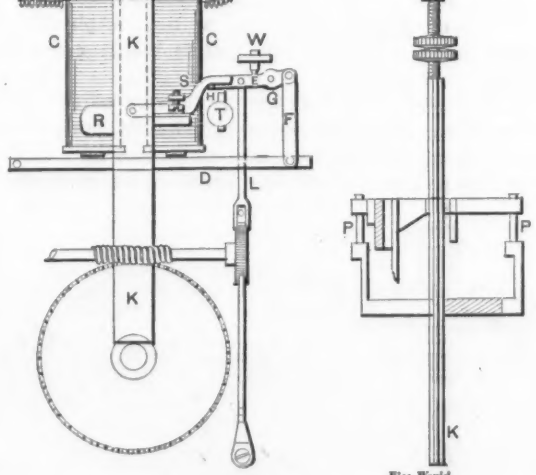


Fig. 1.—The Pentz-Reckenzaun Electric Meter.

vibration of K, so that a rubbing contact is insured in preference to merely the butt contact which might foul slightly after a period of use under practical conditions. The main coil, through which passes the current to be measured, is a solenoid of special shape and very low resistance. It is placed with its centre below the point of suspension of the magnetic pendulum, whose rate of vibration it accelerates positively by virtually increasing the effect of the gravity upon the bar. The relay needle underneath the main coil is deflected by less than the current required by one lamp, and so starts the clocks, which cease to register when the current is switched off.

The adjustments are threefold, the first and second being only attempted by the makers, while the third is open to the meter testers of supply companies. For synchronizing the two bars and timing their vibratory beats, two nuts are arranged on screwed extensions of the pendulums, while the fine adjustment is given by slight variation in height of contact screw, S. These two means enable meters to be calibrated so as to start registering without difficulty, maintain straight line curves, and read directly in units.



Figs. 2 and 3.—The Pentz-Reckenzaun Electric Meter.

If, however, the standards of makers and consumers vary, a final adjustment can be made by raising or lowering the main coil, which is mounted on screwed legs with leveling and back nuts for this purpose. No tampering can occur when the meter has been passed for service, as two covers are used, the first covering up the mechanism and being sealed by the local inspector, while the second contains the three terminals only, the access to which would be open to the supply company, but sealed by them to prevent unauthorized interference. The case of the meter is of japanned metal, fitting airtight to the base. The parts are mounted on a slate base set within a cast metal frame for strength, while the supporting framework of the parts is utilized as magnetic shields, screening the driving gear of the clocks from one another and from the magnetic pendulum, which is given every surrounding possible to insure safety.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

[Inquiries from our patrons for information relative to stocks and bonds of the various electric light and power companies are solicited, and will be answered in this column.]

NEW YORK, May 22, 1893.

NEW YORK GENERAL FINANCIAL STOCK MARKET.

Stocks in general have made a slight advance during the past week, electrical securities included, but it was not a good substantial rise or one that gave promise of lasting. With a resumption of gold shipments there is no probability of a marked improvement in the stock market, but the shaky feeling which prevailed in stocks a week or two ago has entirely disappeared, and there is no likelihood of another general shake up in the immediate future. Many financiers look upon the present strength of the market as merely a temporary reaction and recovery from the past demoralization.

Electrical listed securities have all felt the effects of the slight appreciation and have advanced accordingly, though there has been very little trading in them, not half the number of sales being recorded as in the previous week. This would indicate a disinclination to invest on the part of prospective buyers or that electrical stocks were being held for a rise. There are a number of unlisted electrical securities that are now quoted at low figures which ought to bring much better prices as soon as the money stringency is over.

Edison Electric Illuminating, in which there is never extensive trading, was quite inactive during the week. Whenever a transaction occurred it was only in a limited number of shares, generally less than a hundred at a time. This stock opened at 111½, fluctuated slightly and finally closed but two points above the opening. The Illuminating stock is largely held as investment property, and stockholders and brokers have great faith in its prospective rise.

General Electric stock has had the good fortune of advancing 5½ points during the week, which can be attributed to the upward tendency of all securities. The friends and enemies of the company are so prejudiced in all of their sayings that it is difficult to get an unbiased opinion of the intrinsic value of General Electric securities. The estimate runs all the way from 75 to 140—a pretty wide range. At present General Electric prospects show an improvement upon the affairs of a week or two ago, when the officials were kept busy denying rumors and assertions. A report which comes from a most reliable and "inside" source states that the General Electric Company has secured the contract to build the enormous dynamo for the Niagara Cataract Construction Company, and, though the Cataract people deny the awarding of the contract there is reason to believe that the General Electric people have secured the prize. This will be a drawing card for the company, and may help to boost the stock. General Electric opened Monday at 73, and though closing on that day a fraction below the opening, it gained about two points on each successive day, closing at 78½* This is a very good showing in comparison with other electrical stocks, yet the quotation is pretty low for a good dividend-paying stock.

Western Union was very active during the week and advanced a fraction over three points, closing 85¾. This is also thought to be a very good purchase, considering the company's standing.

Other telegraph and telephone stocks have been inactive for some time, and though a little trading has occurred in them, it has not affected the quotations to any extent.

A number of unlisted electrical securities are now on the market which give promise of being good dividend payers, and which have not the prominence in the financial world that their enlarging business warrants. There are others, like the Detroit Electrical Works, which are undergoing reorganization that may greatly increase their stock values. A few facts about these companies are here given.

Detroit Electrical Works affairs have been in a bad tangle, but the prospects are now good for this company to be put once more on a paying basis. At a meeting held in New York on May 11 a committee was chosen to make a thorough investigation of the past management and present resources of the company and also to take steps for a reorganization. The Detroit Electrical Works was once one of the most flourishing and prosperous electrical factories in the country, it owning many patents and manufacturing a variety of electrical apparatus. Those were the days when the company paid an annual dividend of 10 per cent. and had bright prospects before it. But by a change of management bad times have ensued, until now the stock, with a par value of $10, is offered at 2, and even 1¾, without a purchaser. The investigating committee consists of W. A. Jackson, ex-vice-president of the company; Capt. W. H. Stevens, a heavy stockholder, and W. H. Wells. Hugh McMillan, personal attorney, representative of the McMillan interest. This committee will undoubtedly do everything in its power to put the works once more in a remunerative condition, and it is the opinion of the electrical fraternity that they will be successful. With these facts in view there is every reason to believe that the present stock of the company is offered at a price bound to be a good investment. Nearly all of the stock is now held by Boston and Detroit people, none to speak of being held in New York.

The Electric Construction and Supply Company, whose capital is $225,000, is one of the unlisted securities which is forging into prominence. Its stock is divided into $105,000 preferred and $120,000 common, and during the past year has earned 8 per cent. on the preferred and 25 per cent. on the common. The company declared a dividend of 8 per cent. not long ago, which is an excellent showing for a new, or, in fact, any company. The stock at a par value of 15 is now offered at 16 for preferred and 17½ for common. In comparison with some of the big companies whose capitalizations runs into the millions, the earnings of the Electric Construction and Supply Company are remarkable. The stock is gradually being taken by investors, though there is still a considerable block of it which has not been put out.

The Interior Conduit and Insulation Company, whose stock is now quoted at 45-55, has prospects of a dividend in sight this year. It is claimed by the officials of the company that 6 per cent. was earned last year, but owing to improvements and other business necessities no dividend was declared. The company has brought forward a new motor which is taking well, and expects to largely enhance its business from this source. Most all of the electrical stocks pay good dividends, and yet their quotations are all at low figures. This well exemplifies the condition of the money market at present, and shows the general depreciation which prevails. But better times must come, and though it may not be in the immediate future, electric securities will undoubtedly advance materially.

The West End Street Railway Company has declared a dividend of 4 per cent. on the preferred stock and 4 per cent. on the common, payable July 1 to stock of record June 17. The reduction in the West End semi-annual dividend from $5 to $4, or from 10 per cent. per annum to 8 per cent. was not unexpected, says the Boston News Bureau. The conservative element in the Board has long felt that a 10 per cent. rate was too high during the reconstruction period. No other reason for the reduction is assigned than this "conservatism." President Whitney says the West End Street Railway has still $950,000 to receive from the sale of its bonds and that this sum will provide for its floating debt. He says the floating debt will increase somewhat from this time out, owing to construction work, but it will not be a very important matter. Mr. Whitney further says that he has no intention of resigning from the presidency. The New York *Evening Post* says editorially that its article of some time ago on "The Trolley Nuisance," which gave some statistics about the West End, has been printed in pamphlet form and is being used with the apparent intention of depressing the values of West End stock on the Exchange and to discredit the trolley system everywhere. The *Post* says the trolley nuisance is peculiar to Boston and might become applicable to New York, but has no bearing upon the trolley system in places where Boston conditions do not exist, and that while the operating expenses of the West End road have increased, the income increased in a greater proportion.

The Westinghouse Electric and Manufacturing Company held its annual meeting in Pittsburgh, on May 17, at which the annual report, printed in THE ELECTRICAL WORLD last week, was read. The old board, consisting of the following gentlemen, was unanimously re-elected: Charles Francis Adams, Lemuel Bannister, August Belmont, A. M. Byers, N. W. Bumstead, Marcellus Hartley, George W. Hebard, Henry B. Hyde, Brayton Ives and George Westinghouse, Jr. Messrs. Bumstead, of Boston, and Hebard, of New York, were the only stockholders from out of town who attended in person. Supplementary to his annual report, President Westinghouse said: "It will interest the stockholders to know that there has been a large increase in the orders for electric lighting machinery, and that there are now 598 central stations using our apparatus. There has also been a steady increase in the demand for our railway apparatus, which is now in use upon 233 railways, 110 of which had been users of Thomson-Houston, Edison and Short companies motors. Out of these 110 companies, 17 have discarded the apparatus manufactured by the other companies and now use only that made by our company. The orders on hand, with those received since April 1, the beginning of our fiscal year, aggregate $3,028,048.32—about double the figures at the same date last year. The orders in hand, the current business and the outlook justify the expectation that the business for the current year will be largely in excess of last year. The company has turned out its product during the past three months at the rate of over $8,000,000 per annum, and now has on its pay-rolls 3,942 operatives."

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	25	30
East River Electric Light	100	..	65
Electric Con. & Supply Co. pref.	15	15	16
" " " " com.	15	15	17½
Edison Electric Ill., New York	100	113½	114
" " " 1sts	...	113½	114
*Edison Electric Ill., Brooklyn	100	105	108
" " " Boston	100	140	160
" " " Chicago	100	220	230
" " " Philadelphia	100	135	145
Edison Electric Light of Europe	..	2	6
" Bonds	..	80	85
" Ore Milling	..	5	12
Fort Wayne Electric	..	12½	12¾
General Electric Company	100	78½	78¾
" " deb. 5's	..	92¼	93
Interior Conduit and Ins. Co	100	55	60
Mount Morris Electric	..	..	65
Westinghouse Consolidated	50	..	32
" " pfd	50	..	47

* Ex. div.

NEW INCORPORATIONS.

The Clay City Manufacturing Company, Clay City, Ind., capital stock $25,000, has been formed for electric lighting purposes, etc. W. H. Coleman, C. W. Stover and C. L. Millhouse are the promoters.

The Warrenton Electric Company, Warrenton, Mo., capital stock $5,600, has been formed to operate an electric plant. C. E. Peers, J. H. Frick and B. Livsay, all of Warrenton, are the promoters.

The Priceburg Electric Light Company, Dickson City, Pa., capital stock $20,000, has been formed to supply light, heat and power. J. J. Jermyn, G. B. Jermyn and W. M. Jermyn are the incorporators.

The Electric Traction Company, Philadelphia, Pa., capital stock $50,000, has been formed to supply motive power to passenger railways, etc. J. J. Sullivan, A. Smith and C. S. Ellis are the promoters.

The Christian County Coal Company, Taylorville, Ill., capital stock $25,000, has been formed to generate electricity, etc. The promoters are R. Wilkinson, G. P. Harrington and Wm. T. Vandeveer.

The Equitable Dynamo Company, Chicago, Ill., capital stock $100,000, has been incorporated to manufacture and deal in electrical machinery, etc. C. S. Brown, W. A. Drake and Morris Thein are interested.

The Signal Alarm Company, New Orleans, La., capital stock $10,000, has been incorporated to manufacture electrical apparatus. C. K. Hall, W. B. Lillard, E. J. Hart and Wm. H. Wright are the promoters.

The Metropolitan Electric Engineering Company, Chicago, Ill., capital stock $50,000, has been formed to make and sell electric motors, etc. F. J. Dommerque, C. H. Feischer and J. Staab are the incorporators.

The Chicago Electric Transit Company, Chicago, Ill., capital stock $150,000, has been formed to operate street railways with electric or other power. The organizers are John Cassleman, Henry Wulff and A. H. Hill.

The Bliss Engineering Company, Washington, D. C., capital stock $500,000, has been formed to deal in electrical supplies. The parties interested are L. D. Bliss, W. B. Lewis and C. W. Needham, Washington, D. C.

The Spangler & Hastings Electric Railway Company, Bellefonte, Pa., capital stock $42,000, has been formed to build an electric railway. J. A. Beaver, D. H. Hastings, W. F. Reeder and J. L. Spangler are interested.

The East End & Sharpsburg Electric Railway Company, Pittsburgh, Pa., capital stock $300,000, has been formed to build and operate a railway. E. F. Lukens, W. J. Wagenknight and C. E. Perkins are the promoters.

The Piqua Electric Company, Piqua, O., capital stock $100,000, has been formed to generate electricity for light, heat and power purposes. E. R. Farrington, H. K. Wood, H. Flesh, W. W. Wood and L. M. Flesh are the incorporators.

The Eureka Coal Company, Seattle, Wash., capital stock $100,000, has been formed to erect and operate electric light and power plants, etc. The promoters are A. Hemrich, E. F. Lawson, J. Morris, M. F. Sheehan and Frank Schriener.

The Luzerne, Dallas & Harvey's Lake Railway Company, Luzerne, Pa., capital stock $100,000, has been formed to construct and operate an electric railway. C. A. Spencer, J. B. Reynolds and A. A. Holbrook are the promoters.

The Philadelphia & Rosemont Passenger Railway Company, Philadelphia, Pa., capital stock $150,000, has been formed to build and operate an electric railway. The promoters are P. W. Smith, F. H. Mageoch and J. C. Lynch.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-176 TIMES BUILDING, NEW YORK, May 22, 1893.

The strike of the linemen of the New York & New Jersey Telephone Company in Brooklyn and New Jersey continues.

The Commercial Electric Company, of Indianapolis, Ind., has established a branch office in the Electrical Exchange Building, 136 Liberty street.

W. R. Ostrander & Co., 195-197 Fulton street, New York City, manufacturers of electric bells, annunciators, etc., have removed to 204 Fulton street.

The Manhattan Elevated Railway Company has not yet come to terms with the Rapid Transit Commissioners, and refuses to make further concessions.

Mr. Charles Russell, formerly the Philadelphia representative of the Duplex Electric Company, of Corry, Pa., has been appointed general sales agent of the company, and will soon make a trip through the West on the business of the Duplex company.

P. C. Burns, general manager of the Laclede Carbon and Electric Company, of Peru, Ind., is in New York on a flying visit to the East. Mr Burns is well known in electrical circles as the former manager of the Peru Electric Manufacturing Company, of Peru, Ind.

Mr. William A. Courtland, draughtsman, has moved from Temple Court to the Fulton Building, corner Fulton and Nassau streets. Mr. Courtland reports business exceedingly brisk, having but recently finished drawings for Messrs. Nikola Tesla, John C. Henry, Lieut. F. Jarvis Patten, Ludwig Jutman and Prof. Crocker.

The Wright Universal Electric Company, New York City, has removed from 26 Whitehall street to 126 Liberty street, where it has offices on the ground floor. Dr. Taylor, who is at the head of this firm, states that the demand for his batteries and motors very much exceeds the supply, and the outlook is very gratifying.

The State Electric Light and Power Company has served an order on Mayor Boody, of Brooklyn, requiring the city to show cause in the Supreme Court why it may not be permitted to do business in Brooklyn. Their complaint is the refusal of the Board of Aldermen to give the necessary legal consent to permit them to carry on business, thus establishing a monopoly.

Charles Henry Davis, consulting and constructing civil and electrical engineer, 120 Broadway, New York City, and 208 Walnut street, Philadelphia, has issued a third edition of the little volume entitled "Facts and Figures Interesting to Electric Railroad Men." This little book contains in tabular and statistical form a vast amount of information of practical value to those interested in electric railway work.

The Rapid Transit Commissioners have received a communication from Mr. Geo. J. Gould stating he has obtained the views of the directors of the Manhattan Railway Company, and that they consider that they cannot accept the proposals of the Commissioners. It is expected that Mr. Starin's proposition authorizing the construction of new and independent lines of elevated railways will be revived.

Electric Wiremen.—On Sunday, May 21, 18 firms, comprising the Electrical Contractors' Association, and employing 500 men, advertised for non-union electric wiremen. Delegate Hoadley, of the Brotherhood of Electrical Workers, states that it is the intention of the association to lock out the employés and thus force a fight with the union, and eventually force it out of existence. As a beginning of the fight, he said, the New York Electric Equipment Company discharged 50 union men on Saturday night.

The New York Electrical Society held its 153d meeting on May 17 in Hamilton Hall, Columbia College. George H. Guy, secretary of the society, presided. The speaker of the evening was Dr. William J. Morton, professor of diseases of the mind and nervous diseases in the Post Graduate Hospital. Dr. Morton's subject was "A Brief Glance at Electricity in Medicine." A large electrostatical machine stood at the right of the speaker and was frequently used to illustrate the many interesting points. A number of members of the American Institute of Electrical Engineers listened to the lecture.

Underground Roads.—A certificate of the consolidation of the New York, New Jersey & Eastern Railroad Company and the New York & New Jersey Underground Railway Company, to form the Brooklyn, New York & Jersey City Terminal Railroad Company, was filed in the office of the Secretary of State, at Albany, May 11. The first-named road is authorized to construct an underground railroad from Flatbush and Atlantic avenues, Brooklyn, under the East River and New York City to a point on the New York and New Jersey boundary line, with a branch to New York City a the Battery. The second named road is authorized to construct an underground road from Jersey City or Hoboken, under the Hudson River and New York Bay, to a point on the New Jersey and New York State boundary line, there to connect with the New York, New Jersey & Eastern Railroad Company.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., May 20, 1893.

Cutter & Bishop, of Providence, R. I., have had plans prepared for a large business building. The structure will be wired for incandescent electric lighting.

The Lewis Boiler Company has been organized at Augusta Me., for the purpose of manufacturing the Lewis patent sectional steam and hot water boiler. The company is capitalized at $100,000, with $3,030 paid up. W. A. Lewis, Waltham, Mass., is president; G. T. Lewis, Charlestown, Mass., treasurer.

E. E. Lilly, formerly with Holtzer-Cabot Electric Company, but now representing O. C. White & Co., Worcester, Mass., has

established himself at 92 Franklin street, Boston, Mass., and will give his entire attention in introducing Messrs. White & Company's adjustable electric light holder; it is their intention to sell this directly to the user before offering it to the trade.

The writer of the electrical science column of the Boston *Transcript*, in commenting on the opening of the Columbian Exposition, made a slight error—The E. S. Greeley & Co. would consider it a very grave one—as he tells us the power that set in motion the machinery was received from six Ajax dry batteries. Mr. Greeley tells us the President pressed the "Victor key," and the "Exeter" dry battery did the rest. The facts rather sustained the latter's statement.

Storage Cars May Run.—The chief debate in the House recently was over the bill to incorporate the Storage Battery Street Railway Company, which was passed to its third reading. Mr. Dennis, of Salem, moved an amendment that the company could not use the West End tracks until it had built and operated two miles of track of its own. Debate followed on the lines of the previous stage. The bill was ordered to a third reading by a majority so large that its opponents did not care for a count.

The Boston Advertiser of the 20th inst. contained a short paragraph which was headed "A New Incandescent Lamp," the inventor of which is Mr. S. F. Van Choate. It is claimed for this lamp that it is cheaper to manufacture than the ordinary lamp, and by a new combination of metallic and other substances 600 to 700 c. p. per electrical horse power is produced, as against about 192 c. p. of the Edison lamp. The article goes on to say that a new factory will be established to manufacture the above lamps. We give this to the public as a matter of news and for what it is worth.

Storage Battery Litigation.—In the suit of the Brush Electric Company vs. The Milford & Hopedale Street Railway Company, in the U. S. Circuit Court, before Judge Colt, at Boston, Mass., Messrs. Witter, Kenyon, Bentley, Blodgett and Mitchell represented the plaintiffs. The defendant had Messrs. L. D. Brandeis, Dawse, Edmund Wetmore and W. S. Hill to look after its interests. Judge Colt took the matter under consideration. On account of the complicated state of the case, and the many documents to be thoroughly reviewed, a decision is not expected for at least a month, and not even then unless his Honor decides to give this case precedence over other matters claiming his attention.

WESTERN NOTES.

Branch Office of The Electrical World,
936 Monadnock Building, Chicago, May 20, 1893.

Mr. Charles A. Noll, general agent of the General Incandescent Arc Light Company, of New York, is in charge of the company's handsome and elaborate exhibit at the World's Fair, located at Section E, Space 6, on the ground floor.

The Electric Appliance Company is preparing to distribute to the Western trade its new catalogue of Whitney voltmeters, ammeters, indicators, etc., calling particular attention to its new alternating instruments, especially the alternating ammeters, which are claimed to be the first accurate portable alternating ammeters on the market.

The Star Electric Lamp Company is now operating its factory to full capacity in the manufacture of the new Sunbeam lamp. Large orders are being received from all parts of the United States and Canada, but the capacity of the factory has been so enlarged that all orders can be taken care of promptly. Mr. Terry is receiving the most flattering reports from different consumers who have been using the lamp since its first introduction, indicating more than the ordinary life and efficiency.

The McDonald & Hood Electric Company, 239 La Salle street, has been organized in Chicago to handle a general line of electrical supplies, and to act as general sales agents for the American Battery Company. Mr. J. B. McDonald, the senior member of the new firm, has been well known as the president of the Anglo-American Storage Battery Company, while Mr. Wm. Hood has represented the Accumulator Company in Chicago since storage batteries were in their infancy. The new company will represent a number of specialties, and is certain to meet with success.

The Chicago Insulated Wire Company, under date of May 18, sends out a circular saying that the company heretofore owned and controlled by the Great Western Manufacturing Company has been purchased by Mr. Edward Carroll, Leavenworth, Kan., and that while the old name has been retained an entire reorganization has taken place. The following are the officers recently elected: Edward Carroll, Leavenworth, Kan., president; T. C. Turlay, Chicago, vice president and general manager; W. H. Smith, Sycamore, Ill., secretary and treasurer. This company has a very successful factory in operation at Sycamore, Ill., turning out all grades of weather-proof and magnet wires. The general office is at room 214, Northern Building, Chicago, Ill.

The American Battery Company held its regular annual meeting at the office of the company in Chicago, May 9, at which time the following officers were elected: Jonathan Abel, president; Geo. T. Burroughs, vice-president; Harold Sturges, secretary; Wilson Ames, treasurer. A new factory, built by the Diamond Match Company, 553-561 West Twentieth street, and recently leased by the new company, is being equipped, so that all orders up to any possible demand will be promptly filled. The battery has had a trial extending over a year's time, demonstrating its life and efficiency. This company owns a process for a secondary Plante cell gotten up by Wm. Morrison, of Des Moines, Ia., with a number of patents on an electrical carriage. An exhibit at the World's Fair grounds is being prepared which will include the first road wagon ever operated by a storage battery. The company has recently added largely to its working capital, and by June 10 it is hoped that the output will be at least 150 cells per day.

Oregon City, May 15, 1893.

The East Side Railway Company, of Portland, Ore., has completed a station building at Gladstone, on its Oregon City electric line.

The town of Puyallup, Wash., has discontinued the use of electric lights on the streets. The Puyallup Light, Heat and Power Company had been supplying a number of arc lights for some time.

The Consumers' Electric Supply Company, of Tacoma, has been awarded the contract for the electric supplies and wiring of the two new wings of the Washington State Hospital for the Insane, at Fort Steilacoom.

Tacoma, Wash., citizens have filed a claim to the water right at Nisqually Falls, where it is estimated 10,000 h. p. can be developed. It is said that a company will be formed to transmit the power to Tacoma by electricity at an expense of $400,000.

P. F. Morey, president of the Portland General Electric Company, has returned from New York after visiting the manufactories where the electrical apparatus for the equipment of the company's new station in Oregon City is in course of construction.

The Blue Mountain Telephone and Telegraph Company, which was recently incorporated at Pendleton, Ore., has commenced the construction of a metallic circuit to connect Canyon City with Pendleton, a distance of 80 miles apart on an air line. The capitalization is $50,000.

The Inland Telephone Company's construction force recently reached Umatilla, on their way down the Columbia River toward Portland, Ore. They occupy a flatboat and float their poles down the stream as they advance with the line. The line is now completed a little more than half the distance from Spokane, Wash., to Portland.

The Portland Cable Railway Company, of Portland, Ore., is likely to have its affairs straightened out and put on a paying basis. Secretary Seligman, of the Bondholders' Association of San Francisco, is reported to have said that proper management will be supplied and some changes may be made in the course of the line, part of which may possibly be electrically equipped.

The Portland General Electric Company has completed the construction of its new telephone line from its Oregon City electric station to Portland, Ore. It consists of a lead covered cable, 14 miles in length and five-eighths of an inch in diameter, which contains six copper wires insulated with paper. It weighs 900 pounds to the 1,000 feet and is said to have cost $18,000 in the factory, in Boston. The cable was found necessary to prevent induction from the 5,000 volt circuits which occupy the same pole line.

ENGLISH NOTES.

(*From Our Own Correspondent.*)

London, May 3, 1893.

Comparative Cost of Gas and Electricity.—After several years of vague statements founded upon elaborate estimates based upon a minimum of actual experience, the relative cost of gas and electricity to the householder in this country appears to be arriving within the region of ascertained fact. In an interesting paper, read before the Society of Arts last week, Mr. Gisbert Kapp pretty conclusively showed that there is scope for *engineering* in the apparently humble task of house-wiring and isolated plant design. In the former a parsimonious use of switches and the use of 16 c. p. instead of 8-c. p. lamps may make all the difference between the quarterly electric lighting bills being 25 per cent. more or the same amount less than the corresponding quarterly gas bills. The house of a well known electrical engineer residing in South Kensington, where the Board of Trade unit is 8d. and gas at the time of comparison was 2s. 9d., though it is now 3s. 1d. per thousand, was recently wired throughout and fitted with some hundred 8 c. p. lamps. The total electrical light bill for the year 1892-93, exclusive of lamp renewal and meter rent, was £15 14s. For the year 1888-89 the total annual bill for gas, oil and candles, including meter rent, but exclusive of miscellaneous items required, was £18 8s. 10d. This shows a balance in favor of electric lighting of 10 per cent. which, if meter rent and lamp renewals are included, will leave it on an equality with gas. With regard to isolated plants, Mr. Kapp remarked that it was very slovenly for firms to tender for totally different kinds of installation on a cast iron rule, since in many cases it would be highly to the consumer's advantage to have a very small battery and to overrun his lamps.

Municipal Lighting.—The municipal electric lighting plant at Huddersfield has had to be extended by 30 per cent. before it has got to work, owing to the unexpectedly large demand for current, which is somewhat remarkable in view of the fact that gas at Huddersfield is under 3s. per thousand and the proposed charge for the kilowatt hour is 6d.—On Friday last the Edinburgh Town Council finally and formally decided to itself undertake the electric lighting of that city. As, however, a sufficient number of the members absented themselves on this occasion to convert the minority against electric lighting into a majority, it is probable that the opponents of electric lighting in Edinburgh will still continue their efforts.—On Tuesday the Town Council of Leicester, which has a population of over 180,000 and has spent three-quarters of a million sterling upon its gasworks, decided to make a commencement with an electric lighting scheme, the immediate expenditure contemplated being the modest sum of £25,000, although borrowing powers for £50,000 will be asked for. The subject of electric lighting has received lengthy and unusually intelligent treatment at the hands of the committee of the Town Council. This committee took the customary tour up and down the United Kingdom, viewing the many varieties of central lighting station practice with which this country is blessed. The eager curiosity of the committee, however, led it abroad and the magnificent, horizontal, compound, condensing, slow-speed, direct-coupled Sulzer engines which they saw at Cologne and Düsseldorf completely won their hearts, and although the contract has been given to the Brush company, the committee has had the courage of its opinions and in the face of the prevailing mania for direct-coupled, high-speed, vertical engines, has expressly excluded Raworth and Willans engines from the contract. The system of distribution adopted at Leicester is the alternate current, transformer, sub-station system.—The vestry of Islington, which has a population of 320,000 under its charge, has also decided to adopt electric lighting.

News of the Week.

THE TELEPHONE AND TELEGRAPH.

A telegraph line is being built from Clearmont to Buffalo, Wyo., and will be extended to Fort McKinney.

The Automatic Telephone and Electric Company of Canada proposes to run a copper metallic trunk line direct from Halifax to Vancouver, a distance of 3,500 miles. Local plants will also be established in towns and cities along the line.

THE ELECTRIC LIGHT.

Glasgow, Ky., is to have the electric light.

Phœnix, Ariz., is discussing the electric light.

Sandwich, Ill., is to have an electric light plant.

Centralia, Mo., has voted in favor of the electric light.

Centralia, Mo., has voted in favor of the electric light.

Northville, N. Y., is to have an electric lighting station.

Spirit Lake, Iowa, has voted to adopt the electric light.

Madison, Me., has voted to build an electric light plant.

Colebrook, N. H., is to have a town electric lighting plant.

Valley City, N. Dak., has decided in favor of the electric light.

Havre-de-Grace, Md., is thinking of adopting the electric light.

Middletown, Pa.—A special meeting of council is to be held to take action with regard to holding another election to vote on the proposed issue of $25,000 in bonds, to pay for an electric lighting plant.

The Hamburg Water and Electric Light Company, Hamburg, N. Y., request bids for the construction and furnishing of an electric light plant, both arc and incandescent. Specifications may be had on application.

Camden, N. J.—The Camden, Gloucester & Woodbury Electric road has been incorporated by Wm. J. Thompson, the owner of the Gloucester race track, and it is stated that the road will be completed to Gloucester by July 4.

Erie, Pa.—The Merchants and Manufacturers' Light, Heat and Power Company has applied for a franchise to erect poles and string wires, but no action has yet been taken, the majority of the Council being in favor of a municipal electric lighting plant.

Decatur, Ill.—The Municipal Electric Light Company has been incorporated with a capital stock of $25,000. The object of the company is the transmission and sale of electric heat, light and energy, and the manufacture and sale of electric appliances, gas machines and gas fixtures.

J. P. Gilson & Co., who own the water-power plant at Middle Falls, N. Y., which lights Greenwich and Schuylerville, propose, it is said, to construct a dam and electric light and power plant on the Hudson about eight miles above Glens Falls in order to supply Saratoga Springs and other places.

The Buffalo General Electric Company is largely augmenting its plant. A 1,200-h. p. boiler and 480-h. p. engine are being placed in the new Elk street building, two 500-h. p. engines in the Court street station, and one 500-h. p. engine in the Black Rock station. This company has now 1,600 miles of wire and lights 1,800 city arc lamps.

The Hotel Ponce de Leon and the Casino attached to the Alcazar Hotel are being rewired with Interior Conduit and Okonite wire, and the generating plant will consist of seven 45-kw. Edison machines, five 60-h. p. and one 120-h. p. Armington & Sims engine; and about 6,000 16-c. p. lamps will be installed. The work is under the supervision of Mr. A. T. Best.

A State association, comprising the electric light companies of Pennsylvania, is in process of formation in that State. There are 150 electric light companies in Pennsylvania and the association is intended for their benefit. No attention will be paid to the science of electricity in its application, but the aim will be to watch legislation and look after charter rights, franchises, etc.

THE ELECTRIC RAILWAY.

Manor, Pa.—An electric road to Export is proposed.

West Newbury, Mass., is to have an electric road from Lowell.

Toledo and Detroit are to be connected by an electric railway, it is reported.

Albany and Sandlake, N. Y., are agitating a road to connect the two places.

Shelbyville & Shelbina, Mo., are discussing an electric road between the two towns.

Orange, Mass.—A franchise has been granted to the Orange and Athol Street Railway.

Escanaba, Mich.—The Escanaba Street Railway system will be extended this summer.

Dayton, O., street railways have consolidated, and will use electricity as the motive power.

Binghamton, Owego and Ithaca, N. Y., are considering an electric road to connect those places.

Alexandria, Va., and Washington, D. C., are to be connected by electric roads via Arlington.

Calais, Me., and St. Stephens, N. B., are to be connected by an electric railway 5½ miles long.

The Cleveland Electric Railway Company is meeting with the opposition of the City Council in regard to the recent consolidation of street railways. These companies have consolidated without the consent of the Council and without giving it an opportunity to fix any terms and conditions, and the board will begin proceedings in the courts to determine the legality of such consolidation.

The Lancaster & Philadelphia Electric Railway Company has purchased all the stock of the Lancaster Traction Company, the Lancaster & Columbia Electric Railway Company and the Columbia Electric Railway Company. This gives the company the right to pass through Lancaster with its lines between Philadelphia and Harrisburg, which are now expected to be speedily built.

President Heft, of the Street Railway Company, Bridgeport, Conn., has offered to give bond that his company would build an electric road to Southport within a stipulated time. R. S. Hicks, of Stafford Springs, stated that he represented a syndicate of Boston and New York capitalists, and asked the authorities for a franchise for the Southport Tramway Company. They are willing to have a conditional franchise allowing them to build a road if the Bridgeport Street Railway does not.

The West Jersey Traction Company proposes to build the following electric roads: Route 1, to start from Camden and to run through Pavonia, Palmyra, Riverton, Riverside, Delanco, Beverly, Edgewater Park, Burlington and terminating at Florence. No. 2, to commence in Camden, via Westfield turnpike, to Burlington. No. 3, from Camden to Merchantville, Moorestown and Stanwick. No. 4, from Camden to Collingswood, Haddonfield and Berlin. No. 5, from Camden to Mount Ephraim.

LEGAL NOTES.

Carbon Patent Suit.—L. Waterman has begun a suit in the Circuit Court against A. F. Kiesslich and J. F. Trottmann. The plaintiff claims to be the inventor of a process of making electric light carbons and also of a universal socket. It is demanded of the defendants that they assign to the plaintiff an undivided interest in these inventions.

Injunction Against Private Nuisance.—Evidence that the manner in which defendant conducted his business in one part of a building resulted in continuous vibration, jarring and noises, inconvenient to plaintiffs, located in another part of the building, and to their customers, and that this could be avoided by changing the location of defendant's dynamo and machinery to other portions of the premises held by him, authorizes an injunction against the use of the machinery in such position as a private nuisance, without proof of damage to plaintiff or negligence on the part of defendant.—(Pach v. Geoffroy, Supreme Court of New York 22 N. Y. Sup., 275.)

Brooklyn Street Railway Franchises.—Judge Cullen, in the Supreme Court, Kings county, on May 20, handed down two decisions in important street railway cases. In one the franchise of the Union Railway Company is pronounced null and void, and practically declares the aldermen guilty of fraud and collusion in their action in granting the franchise. In the suit of the Nassau Electric Railroad Company the Court decided that under the

general statute it was not necessary for a majority of property owners to petition for the road, and the injunction obtained on this plea was dissolved.

An Edison electric light meter, according to a decision of the Brooklyn City Court of May 16, overestimated the amount of current used by Lewis Jacobs in his clothing store at 523 Fulton street, Brooklyn, by an amount corresponding to the difference between $122.45 and $32. The Edison company was awarded the latter amount and ordered to pay the costs of the suit, $119. Mr. Jacobs asserted that during the holiday month when the store was kept open late the bill was $65, and that in January, the month in question, the store was closed at 6 o'clock, yet his bill was $122 45, when he estimated that it should be only $32, and this view was accepted by the jury. The case will be appealed.

The Sawyer-Man Electric Company several weeks ago petitioned the Supreme Court of the United States for a writ of certiorari to bring up the record in the case of the Edison Electric Company vs. the Sawyer-Man Electric Company, in which the Court of Appeals ordered an injunction against the defendant because of the infringement of the Edison lamp patent. The Supreme Court on May 16 rendered a decision denying the application of the Sawyer-Man company. This leaves the opinion and injunction of the Court of Appeals against the Sawyer-Mann company, under which name the lamp business of the Westinghouse Electric Company was conducted, in full force and effect.

Street Railway Suit.—The Springfield, O., *Democrat* states that O. S. Kelly, of Springfield, O., and the General Electric Company, of New York, have filed in the United States Circuit Court a bill of complaint against the Springfield Railway Company. William B. McKinley, R. S. Hunter and S. L. Nelson, the complainants, claim that George F. Green, of Kalamazoo, Mich., the inventor of the improvements on means of propelling cars by electricity, received patents on the same and assigned them to them. They claim they have the sole right to collect royalties on cars thus propelled. They ask for an injunction against the defendants using such improvements and ask award of damages. The case will be heard at the October term of court. a temporary injunction being granted against the further operation of the cars of defendant by using the invention of the complainants.

PERSONAL NOTES.

Mr. A. von Siemens, son of the late Dr. Werner von Siemens, is making a tour of inspection in the United States.

Mr. Benj. F. Leavitt, of the Leavitt Motor Company, successor to Porter & Leavitt, of Providence, R. I., is now making a six weeks' trip through the West.

Mrs. Truex, wife of Mr. Chas. E. Truex, of the American Long Distance Telephone Company, was thrown from a carriage in a runaway accident at Central Park, New York, on Friday, May 19. It was at first supposed that the accident was serious, but later it was found that Mrs. Truex had only been slightly injured.

Col. Samuel Franklin, one of the pioneers in the promotion of electrical enterprises in the South, and widely known all over the country, died at Pine Bluff, Ark., last week, of softening of the brain. He was 53 years old, and came in early youth from Posen, Prussia. He built the first cotton-seed oil mill in the South.

MISCELLANEOUS NOTES.

Hickory, N. C.—An electric plant is to be built by Marcellus E. Thornton, to be operated by water power.

A mining haulage plant has been installed in the Brock mine, at Brockwayville, Pa., and all the mules laid off. The longest haul is 1,500 feet.

The University of Pennsylvania has issued its annual catalogue for 1892-3. This institution has now built up quite an extensive course in electrical engineering.

Electrical Canal Propulsion.—The New York Legislature has made an appropriation to defray the expenses of experiments on the propulsion of canal boats by electricity.

Trolley Boats.—Mr. S. W. Gear, of Buffalo, will apply to the state authorities to test his system of electrical canal propulsion, which is a modification of the street railway trolley system.

Somerville, N. J.—The Somerville & Raritan Fire Alarm Association has been formed to erect and maintain a fire alarm system in these towns. Geo. W. Abbott is president, and H. K. Gaston is treasurer.

New York, N. Y.—Sealed proposals will be received to June 13 by Frank Heath Ordnance Department, Sandy Hook Proving Grounds (office, Governor's Island, N. Y.), for furnishing iron, steel, electric materials, etc.

The Massachusetts Institute of Technology, Boston, Mass., has issued its annual catalogue, which is a volume of over 250 pages. This institution has splendidly equipped laboratories and one of the best courses in electrical engineering in the country. The number of students is now a little more than 1,000.

One Hundred and Forty-Six Miles in 135 Minutes.—Engine No. 993 on May 20th made the above speed between Syracuse and East Buffalo. The fastest time was made between Looneyville and Grimesville, when the rate of 100 miles an hour was reached, which was less, however, than the record of engine No. 999—112½ miles per hour.

The Connecticut Legislature has passed a bill relating to street railroads over which there had been considerable discussion. As finally passed the bill permits the carrying of freight unless it is stopped by a competing road, in which case the matter goes to the Superior Court, which will also decide the question of paralleling steam or electric line and decide the necessity of a line.

The Engineering Association of the South held its regular monthly meeting at Nashville, Tenn., on May 11, the resident members extending their courtesies to the non-resident members in an excursion to various points of interest near that city. At the evening session a discussion took place on the "Durability of Yellow Pine." The next meeting will be held on June 3, 1893, at the rooms of the Association in Nashville.

The Detroit Telephone Company, Detroit, Mich., has moved into its handsome new building and has now one of the model exchanges of the world. The building fronts 100 ft. on Clifford street and 61 ft. on Washington avenue and is six stories high; it is built of brick, with brownstone trimmings and of slow burning construction. The operating room is on top and is practically open to the light on three sides, with a skylight overhead. The wires are underground and enter the building in cables of 200, the total number being over 10,000.

Water Power Plant.—The Glens Falls (N. Y.) *Times* is authority for the statement that it is probable the plan of establishing a gigantic electric plant for furnishing light and heat and motive power for several towns in the vicinity of Glens Falls will be effected. The plan of the capitalists who have the scheme in hand is to dam the Hudson about eight miles above Glens Falls. The dam would cost about $45,000, and the plant complete would require an expenditure of $500,000. Mr. Jesse Stiles is said to represent the Saratoga Springs parties who are interested.

A large water-power electric plant is projected near Pomona, Cal. The power is to be located at Mill Creek Falls, in San Bernardino county. An idea of its proportions can be gotten from the fact that the plant in San Antonio Cañon gets its power from a 400-foot fall of water, while the one at Mill Creek Falls will be one of 1,596 feet. The idea will be to run wires to almost any of the towns such as San Bernardino, Riverside, Redlands, Ontario, Pomona, etc. The company is formed out of the San Antonio company, and the two companies will not conflict.

The Railway Telegraphers' Grand Order held their annual convention in Toronto beginning May 15, and lasting five days and some 200 delegates visited Niagara on the 20th. The organization this year reports nearly 6,000 more members than last, and is in a most prosperous condition. It is understood that measures were taken to secure the closest co-operation in the case of strikes or freeze-outs. The officers elected for this year were: Grand Chief, D. G. Ramsay, of St Louis; Assistant Grand Chief, Daniel Gerhart, of Mauch Chunk; Secretary and Treasurer, J. Weatherly, of Argo, Col.; Grand Editor, A. D. Thurston, of Clinton, Ia.; Grand Senior Telegrapher, J. A. La Canda, City of Mexico; Grand Junior Telegrapher, W. J. Williamson, of Toronto; Inside Sentinel, T. N. Pearson, of Terre Haute; Outside Sentinel, T. J. Flynn, of San Francisco. Executive Board: A. L. Taylor, of Warren, O.; T. J. Roach, of Chicago, and W. W. Yateman, of Nashville.

The Charges Against the Late Commissioner of Patents.—The numerous rumors which have been in circulation in the Department of the Interior for several weeks questioning the official integrity of W. E. Simons, Commissioner of Patents, culminated on May 17 in the filing of formal charges against Mr. Simons, and Foster & Freeman, attorneys in Washington for the Bell Telephone Company, by Messrs. Church & Church, alleging improper inspection of the secret files in the Drawbaugh telephone case and the unlawful taking of copies thereof for the private use of Mr. Simons and the Bell Telephone Company. Chief Clerk Bennett, of the Patent Office, is also involved in the charge, and the Commissioner is requested to demand that Mr. Simons and Messrs. Foster & Freeman show cause why they should not be disbarred from practicing before the Patent Office. Chief Clerk Bennett does not deny the charges of furnishing copies, but states that it was his business to obey orders and that he would do it again if necessary. Mr. Simons emphatically denies the charges and states that he is ready for an investigation. He claims that there is absolutely no ground for these accusations, and also says that there is no law to prevent anything but the caveats filed in the Patent Office from being made public, and that this point was decided by Judge Lacombe in one of the Edison incandescent lamp cases. Mr. Simons is from Connecticut, where he served as speaker of the lower House. As a member of Congress he became well known for his connection with the International Copyright law, and for which he received the cross of the Legion of Honor.

Trade and Industrial Notes.

Syracuse, N. Y.—The Electric Engineering & Supply Company, $50,000, with offices at 308 West Jefferson street, is to be reorganized and the business extended.

The Manhattan Electrical Supply Company, 36 Cortlandt street, New York City, has issued a new edition of 50,000 copies of its catalogue, describing and illustrating all the various supplies handled by it.

The Laidlaw-Dunn-Gordon Co., of Cincinnati, O., successors to the Laidlaw & Dunn Company, manufacturers of steam pumping machinery, have secured a contract for pumps, boilers, etc., for a water-works plant which the town of Reading, O., is about to erect.

The Canton Electrical Company, Canton, O., is sending out a very neat little catalogue describing the Keller system. This company manufactures motors from ⅛ h. p. up to 30 h. p. The ¼-h. p. motors are formed for 110, 220 and 500 volts, and the generators are all wound for 110 volts unless otherwise specified.

The Shawmut Fuse Wire Company, Boston, Mass., on account of the recent fire in its office and factory at 161 and 163 High street, has been obliged to move its offices temporarily to 85 Water street, and its factory and storeroom to 54 Pearl street. The company is well equipped in its new quarters and prepared to continue its business as before.

Munson Brothers, Utica, N. Y., manufacturers of feed mill machinery, shafting, pulleys, gearing and turbine wheels, have recently sold the following Little Giant turbines: Oxford Electric Light Company, one 18-inch wheel; Homer, N. Y., one 14-inch; Redford, N. Y., one 21-inch; Solsville, N. Y., one 24-inch; and Chester, Mass., one 21-inch wheel.

The Edison Electric Light Company of Philadelphia, 909 Walnut street, Philadelphia, Pa., have published an artistic catalogue descriptive of the company, and containing instructions to consumers. It includes a fine portrait of Thomas A. Edison, with a biographical sketch. This beautiful brochure may rank as an *édition de luxe* among works of its class.

The Southern Electrical Manufacturing and Supply Company, Limited, New Orleans, La., according to a folder which it is sending out, has installed electric plants to a total of nearly 14,000 lights. The sugar plantation installations are the most numerous, reaching 3,972 lights, while 2,430 lights have been installed in sugar refineries and 2,105 central station lamps have been placed.

The Viaduct Manufacturing Company, of Baltimore, Md., is meeting with unusual success in the introduction of its new return signal messenger call-box. It has recently completed an order, received from one district telegraph company alone, for 800 of them, in addition to numerous smaller orders from all parts of the country. It claims that this call-box has no superior, taking into consideration the price, workmanship and quality of the material used in its construction.

The Interior Conduit and Insulation Company's (New York) new catalogue is a handsome specimen of artistic work. In addition to a description of the many devices applicable to interior wiring the catalogue contains complete specifications for the installation of the interior conduit system and also a code for customers who may wish to order by telegraph or cable. The Johnson switch, the Lundell motor and all devices are constructed to conform to standards, and are particularly applicable to the Edison system of distribution.

The Jerome Kidder Manufacturing Company, 820 Broadway, New York, continue to receive the encomiums of the medical profession. In a recent letter, Dr O. F. Kennedy, of Battle Creek, Mich., writes: "I have tested your electro-medical apparatus pretty thoroughly, and find it all that could be desired, and much better than I expected. I regard you as a true benefactor of mankind, and I am sure it must have taken close application and hard study on your part to have produced a machine so perfect in all its parts."

The Hill Clutch Works, Waverly avenue, Cleveland, O., have recently received contracts for shafting, clutch pulleys, etc. from the following companies: N. W. Gokey & Son, Jamestown, N. Y.; Aurora Street Railway Company, Aurora, Ill.; Star Electric Company, Dubuque, Ia.; Hartman & Markward, Warrensburg, Mo.; Marshall Electric Light and Power Company, Marshall, Mo.; Mexico Electric Light Company, Mexico, Mo.; Carbondale Traction Company, Carbondale, Pa.; M. C. Bullock Manufacturing Company, Chicago, Ill.

The Onondaga Dynamo Company, of Syracuse, N. Y., has recently shipped to Charles Tolliner, of Pulaski, N. Y., one 500-light dynamo and complete installation: O. F. Heath, Northville, N. Y. one 500-light incandescent dynamo, one 25-light arc machine and complete plant; Muncie, Pa., Woolen Mills, one 100-light dynamo; Rochester, N. Y., Basket Works, one 100-light dynamo; Racquette Rubber Company, one 100-light dynamo; Esperance, N. Y., Knitting Mills, one 100-light dynamo; Hotel Royal, Fonda, N. Y., one 500-light dynamo and complete plant; Andrews Brothers, Syracuse, N. Y., one 500-light dynamo.

The Elektron Manufacturing Company, of Springfield, Mass., is experiencing a lively demand for its improved electric elevators, and for the convenience of its customers in that vicinity has recently opened an office at 103 Milk street, Boston, and has installed Mr. E. Marshall as manager of the elevator department, and Mr. F. B. Corey as manager of the electrical department, in which both are well qualified to successfully handle their business. Mr. Marshall has had long experience in connection with elevators with the Otis and Graves hydraulic power apparatus. The Boston office has recently installed electrical elevators for Curtis & Bolster and Frank Ferdinand, of Boston. The main office at Springfield has recently sold electric elevators to the new Masonic Hall in Springfield, Brown, Thompson & Company, Hartford, Conn., and W. H. King & Sons, Springfield, the last being a second order.

The Ansonia Electric Company's World's Fair Bureau has sent us a beautifully engraved invitation extending to us the compliments of the Ansonia Clubrooms for the period of six months from May 1, 1893. The third floor of the Ansonia company's large building, corner Michigan and Randolph streets, has been turned into spacious and elegantly furnished clubrooms. Here every hospitality known to club life will be dispensed with an old time graciousness and good-will that will certainly carry a cheerful warmth into the heart of the "wayfaring electrical man." The arrangements for the necessary carrying out of this hospitable scheme have been placed in the hands of Mr. George B. Shaw. Mr. Shaw has also charge of the exhibit made by the Ansonia Electrical Company, which can be found in the beautiful pavilion occupying the north end of the gallery in the Electricity Building.

The Stirling boilers, manufactured by the Stirling company, continue to meet with favor. J. Bradford Sargent, 620 Atlantic avenue, Boston, Mass., reports a sale of 4,000 h. p. in the week ending May 12, as follows: Ætna Iron Company, Bridgeport, O. (4th order), 1,000 h. p.; Whitman & Barnes Company, Chicago (2d order), 1,000 h. p.; Cleveland Street Railway Company, Cleveland, O., 750 h. p.; Allentown Electric Street Railway Company, Allentown, Pa., 900 h. p.; La Fayette Street Railway Company, La Fayette, Ind. (2d order), 250 h. p.; Hope Company, Hope, R. I., 100 h. p. The sales of the Stirling boiler from March 1, 1892, to March 1, 1893, which was the fifth year of the boiler's existence, amount to 58,000 h. p. F. A. Schifflin, general sales agent, 74 Cortlandt street, New York City, reports the following sales during the last few days: Edison Illuminating Company, Bellefonte, Pa., 125 h. p.; Edison Illuminating Company, Martinsburg, W. Va., 400 h. p.; Lehigh Coal & Navigation Company, Lansford, Pa., 400 h. p.; Hope Mill, Providence, R. I., 100 h. p.; Consolidated Smelting Company of Kansas City, Argentine, Kan., 250 h. p.

The Philadelphia Engineering Works, Ltd., Philadelphia, Pa., have issued a very handsome catalogue, bound in red cloth and gilt, which is considerably more elaborate than it is customary to find in this class of literature. The frontispiece illustrates the splendid works of the Tennessee Coal, Iron & Railroad Company, of Ensley, Ala., which was engineered and started by the present managing chairman of the Philadelphia Engineering Works, and of which their predecessors were the engineers. Following this are general views of the different portions of the blast furnace, illustrations of the Gordon-Cowper-Whitwell-Stokes stoves with details of the valves, different types of blowing engines, etc., the feed-water heaters, iron and steel plate chimneys, barrow and patent cinder car, details of the blast furnace proper, a series of valves, cast iron flange patterns, elbows, saddles, hot blast furnaces, china valves and inlet valves, and an arrangement for cleaning firebrick stoves, gas producers, accumulators, etc. Following these are a series of tables giving the atomic weights and specific gravity of elements met in blast furnace practice, specific heats and gravity of gases, the weight, composition, etc., of the atmosphere, etc., selected and arranged to facilitate the calculations frequently required by those engaged in this business. A number of other interesting features are found in the catalogue, including some of ruled sheets for conveniently entering the composition of the various metals met with in practice.

The Deane Steam Pump Company, of Holyoke, Mass., has seventeen of its machines on exhibition at the World's Fair, and all but one are in actual operation on work in the several departments. One of the machines, forming a part of the United States Patent Office exhibit, is a section of its boiler feed pump. It shows the construction of the interior of the pump and the working of the Deane patent valve motion. It has two duplex pumps in the main boiler room, furnishing feedwater for boilers; and in the Machinery Building there are two Deane air and circulating pumps, each in connection with a Wainwright surface condenser, on a Westinghouse compound engine. In the Western Dummy Railroad Companies' power house there is a Deane patent independent condensing apparatus on a McIntosh & Seymour compound engine. The condensing apparatus consists of a vacuum pump with a jet condenser. All of the pumping machinery in the Ice and Cold Storage Building on the Fair Grounds is furnished by the Deane Steam Pump Company. There are seven duplex pumps, pumping brine and water, and two duplex and two duplex double plunger pumps feeding boilers. The double plunger pumps are furnishing water to boilers which carry a steam pressure of 300 pounds. The headquarters of the Deane company are in the Ice Building, which is near the main entrance on the right-hand side. This building will be one of the most interesting exhibits at the Fair. Mr. Charles Howard is manager of the Chicago office and warerooms of the Deane Steam Pump Company at No. 226 and 228 Lake street. Mr F. S. Scott will be the engineer in charge of the pumps of the company on the Fair Grounds.

Business Notices.

Transformers rewound and repaired. Write for prices. The Hill Manufacturing Company, Salem, Va.

Oil Filters for sale cheap. Prices on application to Purity Oil Filter Manufacturing Company, 901 Water street, Pittsburgh, Pa.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

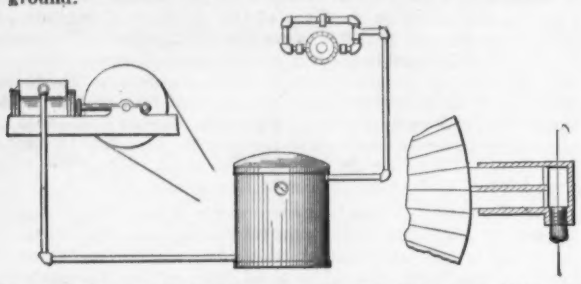
OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

UNITED STATES PATENTS ISSUED MAY 16, 1893.

[In Charge of W. A. Rosenbaum, 177 Times Bldg., N. Y.]

497,310. Automatic Disconnector; Wm. A. Cullen, Paterson, N. J. Application filed Jan. 28, 1893. The combination in an automatic disconnector of spring controlled rods of a wire support, with recessed blocks pivotally secured to the outer ends of the rods and adapted to receive the ends of the line wire.

497,324. Process of Making Mica Insulating Plates; Charles W. Jefferson, Schenectady, N. Y. Application filed Feb. 15, 1893. This process consists of making mica plates from mica sheets and cement, consisting in distributing the sheets evenly upon and within the cement while in a liquid condition, by the action of gravitation and resistance of a fluid during the fall of The sheets through the fluid from such a height above the cement that the sheets become substantially parallel to a horizontal plane before reaching the cement, expelling the excess of cement by pressure, drying the plate thus formed, and finally grinding the surfaces of the plate until opposite sides are ground.



No. 497,361.—COMMUTATOR BRUSH-HOLDER FOR DYNAMO ELECTRIC MACHINES.

497,335. Manufacture of Telephone Cables; Wm. R. Patterson, Chicago, Ill. Application filed Aug. 24, 1891. A method of twisting wires into strands which consists in twisting the wires together and simultaneously giving the wires a longitudinal motion and definitely varying the relation between the rates of twisting the wires together and the longitudinal motion thereof.

497,336. Insulating Tape; Wm. R. Patterson. Application filed Aug. 24, 1891. This tape is adapted when wound into a helix to buckle upon one or more interior lines to form helical ridges on the tape.

497,337. Overhead Electric Railway; Wm. D. Patterson, Keokuk, Ia. Application filed Nov. 1, 1892. The combination, with wires supported above the track in substantially the same horizontal plane, of posts, carried upon the wires and free to move longitudinally thereon, and a trolley wire carried on these posts.

497,356. Electric Car-Truck; Geo. S. Strong, New York. Application filed Jan. 25, 1892. In a car truck springs extending between the axles a frame supported thereon and having pedestals engaging the axle boxes, in combination with an electric motor field supported on the frame and resting directly over the springs, and a car body supported pivotally directly on the field and through it upon the spring support of the frame and field.

497,361. Commutator Brush-Holder for Dynamo Electric Machines; Elihu Thomson, Swampscott, Mass. Application filed Nov. 2, 1891. The combination with the commutator brush of a fluid pressure device acting on the brush to force it in contact with the commutator or traveling contact. See illustration.)

497,366. Rheostat; Parvin Wright, Denver, Colo. Application filed Jan. 16, 1892. A rheostat made of a continuous thin sheet of high resisting material notched at stated intervals and folded back and forth upon itself, the folds being separated by sheets of insulating material, such as mica.

497,377. Trolley for Conduit Railways; Paul C. Just, Chicago, Ill. Application filed April 20, 1892. The combination with a dependent support of studs projecting laterally therefrom, springs mounted on the studs and having a limited horizontal oscillation, a plate supported by these springs and rollers supported by the plate.

497,394. Conduit Electric Railway; George Westinghouse, Jr., Pittsburgh, Pa. Application filed April 8, 1892. A conduit for electric railway conductors, consisting of a trough, a cover therefor, and slot rails extending upward from the cover and constituting the sides of the upper portion of the conduit. (See illustration.)

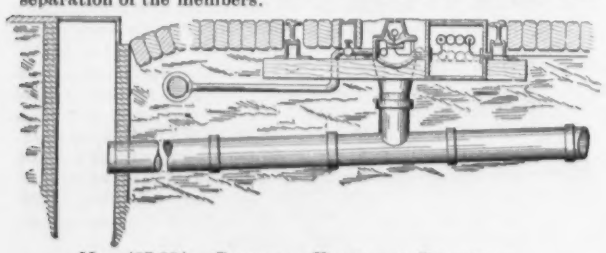
497,397. Lightning Arrester; Alex. Wurts and Chas. F. Scott, Pittsburgh, Pa. Application filed Oct. 26, 1892. A generator, a main line fed thereby, a grounded body of running water, and a continuous electrical connection between a point on the main line near the generator and the body of water.

497,404. Electric Cigar Lighter; Wm. P. Carstarphen, Jr., Denver, Colo. Application filed Aug. 17, 1892. This lighter consists of a divided hand piece, the parts being normally held in such relative position as to break the circuit, one part of the handle being provided with a column of high resistance material located in the circuit.

497,408. Electric Railway Signal; Wm. H. Jordan, Brooklyn, N. Y. Application filed Sept. 10, 1892. In an electrical signaling system for railways, the combination of a main circuit, an auxiliary circuit, a signal circuit connected between the auxiliary circuit and the earth or other return of the main circuit, and means carried by a car for maintaining electrical connection between the main and auxiliary circuits.

497,411. Push Button Switch; Fred. S. McGregory, Revere, Mass. Application filed Jan. 21, 1893. This consists of a circuit closing disc, having alternate metallic and non metallic faces, an electrode metallically connected to the disc, and a yielding spring metal sweeper adapted to bear against it combined with a spring pressed pawl lever adapted to engage a ratchet on the circuit closing disc, a movable push button and a cone or wedge for actuating the pawl lever.

497,430. Circuit Protector; H. W. Leland, Jersey City, N. J. Application filed Aug. 6, 1892. A circuit connector having as one member a conducting socket, and as the other an insulating plug having electrodes and a circuit closing spring provided with a locking tongue entering a recess in the socket to prevent accidental separation of the members adapted to be actuated upon separation of the members.



No. 497,394.—CONDUIT ELECTRIC RAILWAY.

497,436. Sectional Contact Conductor for Electric Railways; Geo. Westinghouse, Jr., Pittsburgh, Pa. Application filed April 11, 1892. A circuit controlling device consisting of electrical contacts respectively connected with the main conductor and the contact rail, a plunger projecting through the rail and a controlling device moving with the car for operating the plunger. (See illustration.)

497,438. Arc Electric Lamp; J. C. Wray, Peoria, Ill. Application filed March 21, 1892. Any construction of an arc electric lamp in which the main and shunt coils are provided with a core, consisting of two longitudinal sections, in movable relation to each other.

497,439. Wire Hanger; Arthur J. Wylie, Rome, N. Y. Application filed Oct. 14, 1892. A block or bracket having separated wire grooves and threaded perforations at its rear side opening into each groove, a removable face or cap plate inclosing the grooves and separable partition tubes having threaded ends removably engaging the threaded perforations in block or bracket.

497,448. Galvanometer; A. H. Hoyt, Manchester, N. H. Application filed May 9, 1892. The combination of a field magnet and needle movable in the field thereof, with a solenoid and movable core piece therein, and means to adjust the core piece relative to the needle.

497,449. Galvanometer; A. H. Hoyt, Manchester, N. H. Application filed May 9, 1892. The combination of solenoids, flat or oval, in cross section with the armature pivoted at one end through the solenoid and provided with a weighted arm opposing a variable resistance to its oscillatory movement.

497,450. Electric Arc Lamp; R. M. Hunter, Philadelphia, Pa. Application filed Sept. 22, 1892. The combination of two carbon holders insulated from each other, a third having vertically adjustable current supporting clamps carried thereon, an electric regulator to move the third carbon holder vertically and an electric circuit including the regulator and the two first mentioned carbon holders in series.

497,468. Dynamo Electric Machine or Motor; W. K. Freeman, Boston, Mass. Application filed Nov. 3, 1892. In a dynamo electric machine or dynamo a plate having field core pieces projecting in opposite directions from its two faces, and provided at its top with projections to support the armature and at its bottom with a foot or projection to form a support for the machine.

497,482. Shunt for Electric Light and Power Stations; Edward Weston, Newark, N. J. Application filed Nov. 28, 1892. Two fixed blocks or masses of conducting material forming terminals and two or more conductors extending between the blocks and having a free opening or air space between them.

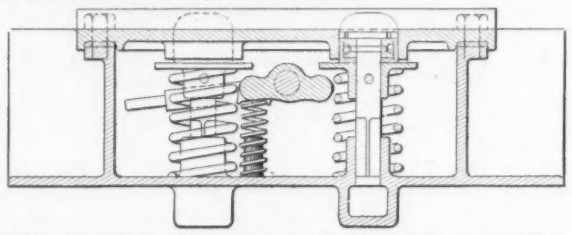
497,489. Circuit Controlling Device; J. P. Buchanan, Boston, Mass. Application filed Oct. 15, 1891. The combination in electric relays of a movable metallic medium actuated by an armature, a non-fusible rest insulation, closing point, back stop and connections.

497,491. Automatic Cut-Out for Electric Light Circuits; Chas. Cuno, Wauwatosa, Wis. Application filed April 16, 1892. The combination of a switch for opening and closing the circuit, magnets arranged to open and close the switch, two contact pieces connected respectively with the windings of the magnets, a movable part in parallel with the lamp circuit, normally engaging the contact piece in connection with the closing magnet, and a magnet having its winding connected with the lamp circuit, and arranged to move the movable part toward the contact piece, in connection with the opening magnet, a distance corresponding with the strength of the current in the lamp circuit.

497,494. Electric Arc Lamp; James Einstein, Munich, Germany. Application filed Nov. 23, 1892. The combination of carbon carriages, their supporting drums, straps running on the drums, the rods in which they terminate, and means for adjustably connecting the rods with the carriages.

497,495. Electric Rink; M. W. Hassan, Rochester, N. Y. Application filed May 28, 1891. The combination in a rink or hall of a ceiling, provided with electrically charged strips arranged in pairs and forming a track, a non-conducting floor provided with guide lines coincident with the strips, a vehicle provided with a motor, a trolley provided with double bearings connected with the strips of each pair forming the track, and electrical conductors connecting the trolley bearings with the motor.

497,504. Armature Core for Electric Motors; J. E. Stuart and U. S James, Helena, Mont. Application filed Oct. 24, 1892. A shaft, a core thereon, having a series of radial angular corners forming a series of longitudinal V shaped grooves, and wire coils wound longitudinally around the core and resting in these V-shaped grooves, the coils crossing the ends of the core at one side and entirely free of the shaft.



No. 497,436.—SECTIONAL CONTACT CONDUCTOR FOR ELECTRIC RAILWAYS.

497,507. Lightning Arrester; Alex. Wurts, Pittsburgh, Pa. Application filed Dec. 22, 1892. For protecting electric lines from disruptive discharges, a mass of uninsulated comminuted metal and means for making good electric connections between the mass of such metal and the line. (See illustration.)

497,508. Lightning Arrester; Alexander Wurts, Pittsburgh, Pa. Application filed Dec. 22, 1892. As a means for protecting an all metal circuit from atmospheric electricity, a lightning arrester connected to one leg of the circuit and a condenser having its opposite plates connected respectively with the two legs of said circuit.

497,509. Lightning Arrester; Alexander Wurts, Pittsburgh, Pa. Application filed Dec. 22, 1892. As a means for protecting electric lines from the effects of atmospheric electricity, a condenser having one plate connected to the line and the other plate grounded, and a high resistance leak around said condenser.

497,515. Insulator; Thomas A. Brady, New Britain, Conn. Application filed Jan. 16, 1893. An insulator and clip, consisting of the insulating block having a wire recess or groove therein, the clip with one end adapted to cover said groove and the screw and socket for holding said clip in place.

497,521. Electric Measuring Instrument; Adrian H. Hoyt, Manchester, N. H. Application filed Nov. 14, 1891. An electrical indicating instrument comprising a field magnet and an indicating armature or needle pivoted in the field thereof, combined with a bridge or keeper connecting the poles of the said magnet and modifying the effect of the magnetic field upon said needle.

497,522. Galvanometer; Adrian H. Hoyt, Manchester, N. H. Application filed Nov. 14, 1891. The combination of the pivoted indicating armature or needle with the coil and the field magnet, having its extremities connected by a magnetic strip and having adjustable polar connections co-operating with the said needle.

497,529. Stop Mechanism for Steam Engines; Wm. M. Wood, Elmira, N. Y. Application filed June 20, 1892. This comprises a steam engine cylinder, induction pipe, a valve in same, a cord operatively connected to rotate this valve to close it, a weight on the cord, a lever to which the cord is connected, a pawl on the lever adapted to engage with a dog, and means to disengage the pawl.

497,535. Process of Manufacturing Electric Conduit Sections; James F. Cummings, Detroit, Mich. Application filed July 12, 1892. The method of forming conduit sections, consisting of arranging a tube within a tube, with centering means at two or more points between the tubes, partly filling one end of the outer tube, injecting a liquid non-conducting substance into the space between the tubes and finally permitting the substance to harden.

497,536. Underground Conduit for Electrical Conductors; James F. Cummings, Detroit, Mich. Application filed July 28, 1892. In an underground conduit for electrical conductors, the combination, with inner conduits, of outer conduits shorter than the inner conduits, clamping means between the outer and inner conduits, plugs at the ends of the outer conduit, insulating material between the adjacent plugs and on the inner conduits, and clamping sleeves over the ends of the conduits and insulating material.

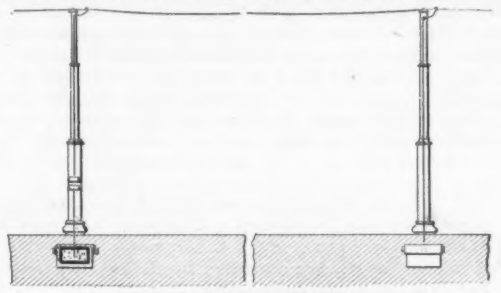
497,539. Electrical Measuring Instrument; Oscar Frolich, Berlin, Germany. Application filed Oct. 25, 1892. An electrical measuring instrument, comprising a conductor, a pair of electromagnets, the coils of which are parallel with the conductor, a pivoted, bell-shaped portion of soft metal located between the opposite poles of the magnets, a pointer on said bell-shaped portion, and a scale over which the pointer moves.

497,540. Device for Illuminating Gun Sights by Electricity; G. Garassino di Giovanni, Turin, Italy. Application filed Sept. 19, 1892. The combination with a gun having a sight, of an electrical lighting device adapted to be mounted near the sight, said device comprising a generator, a circuit, a normally open circuit closer in said circuit, and an incandescent lamp also in said circuit, and so arranged as to illuminate the sight on the gun when the circuit is closed.

497,552. System of Conductors for Electric Fire Engine; Joseph Sachs, New York, N. Y. Application filed May 26, 1892. The combination of a multiple arc working circuit, a resistance at the outer end thereof maintaining the circuit continuously closed, a testing generator, and a test instrument responsive to changes in either limb of the circuit.

497,558. Electric Arc Lamp; Frank H. Thompson, Philadelphia, Pa. Application filed Jan. 19, 1892. A bushing for an electric arc lamp, consisting of a sleeve having a contact plate movable in a groove in said sleeve and provided with a lip on its outer end, a screw passing freely through said lip into said sleeve, and a spring bearing against the head of said screw.

497,563. Electric Pump Governor; Charles R. Whittier, New York, N. Y. Application filed Aug. 8, 1892. As a means for controlling pump mechanism, the combination, with an electric motor and pump driven thereby, of a switch, a series of contact pieces, and connections therefrom to a source of electricity, a controlling diaphragm in the chamber subject to the pressure of the fluid delivered from the pump and acting through a balanced



No. 497,507.—LIGHTNING ARRESTER.

valve on the fluid controlling the plunger connected to said switch, all arranged for joint operation.

497,585. Closed Conduit for Electric Railways; Archibald J. Martin, Philadelphia, Pa. Application filed Sept. 13, 1892. A tube made in longitudinal sections, combined with depressible track slips having insulated stems passing through the section bearing the track slip and adapted to make connection with the conductor in the lower half of the tube.

497,601. Junction Box; James J. Powers and Robert Van Buren, Brooklyn, N. Y. Application filed Dec. 27, 1892. An electrical conduit section, formed of clay or analogous material, and having a removable portion, and a fitting consisting of a box adapted to the side of the conduit and provided with a removable cover and apertures for the service wires.

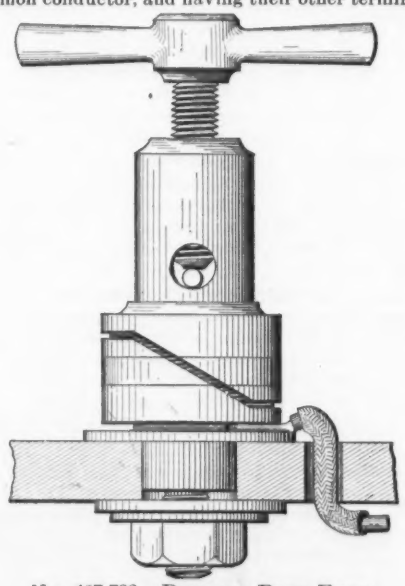
497,649. Magneto Telephone; James P. Freeman, Washington, D. C. Application filed May 16, 1892. In a magneto telephone, the combination of a permanent magnet, a metallic diaphragm connected with one pole thereof, an insulated core mounted upon the other pole with one end adjacent to the diaphragm, and a helix wound about the core, the parts being so disposed relatively to each other that the lines of force between the poles of the magnet cut the coils of the helix at right angles.

497,669. Amalgamator for Gold or Silver Ores; Alfred B. Kittson, Boston, Mass. Application filed Nov. 15, 1892. In an amalgamator, the combination of an amalgamating pan and means for revolving the same, with a feeding tube having an opening extending radially across one side of the pan and above the bottom of the same, and with means for forcing a current of air and ore combined through said tube, whereby said ore may be spread over and subjected to the action of a continuous body of unbroken mercury contained in the pan.

497,680. Safety Cut-Out Apparatus for Networks of Multiple Electrical Conductors; Paul Nordmann, Berlin, Germany. Application filed Nov. 25, 1892. The combination with two or more conductors, of fusible safety strips in circuit with each of said conductors, and a body of non-conducting combustible material enveloping said safety strips.

497,732. Binding Post Fuse; Simon H. Stupakoff, Pittsburgh, Pa. Application filed Sept. 5, 1892. A binding post having in combination two metal parts having grooves formed in their outer parts, one of said parts being provided with means for securing the post to a suitable support, insulating material interposed between the metal parts, and a strip of fusible metal frictionally held in said grooves and forming an electrical connection between the metal parts. (See illustration.)

497,755. System of Electrical Distribution; Waldemar Meissner, Konigsberg, Germany. Application filed Oct. 23, 1889. In a system of electrical distribution, the combination of main conductors, an electric generator connected to said main conductors, groups of translating devices arranged in parallel series between said main conductors, intermediate conductors between the groups, and compensating generators directly connected by one terminal to one of the main conductors as a common conductor, and having their other terminal individ-



No. 497,732.—BINDING POST FUSE.

ually connected to one of the other conductors in such a way as to maintain constant potential in the various groups of devices, irrespective of their loads.

497,756. Circuit Switch; Ernst Woltmann and Harry A. Triggs, Denver, Colo. Application filed Jan. 17, 1893. In a circuit switch the combination of a two part rotating contact disc composed of conducting and insulating material, three contact brushes engaging said disc, the construction of which is such that one of the brushes is continuously in contact with the conducting material, while the other two are alternately in contact with the conducting and insulating parts, and a single push button or bar for operating the disc.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886 *—can be had for* 25 *cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y*